

THE NATURAL INCREASE
OF MANKIND

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BY
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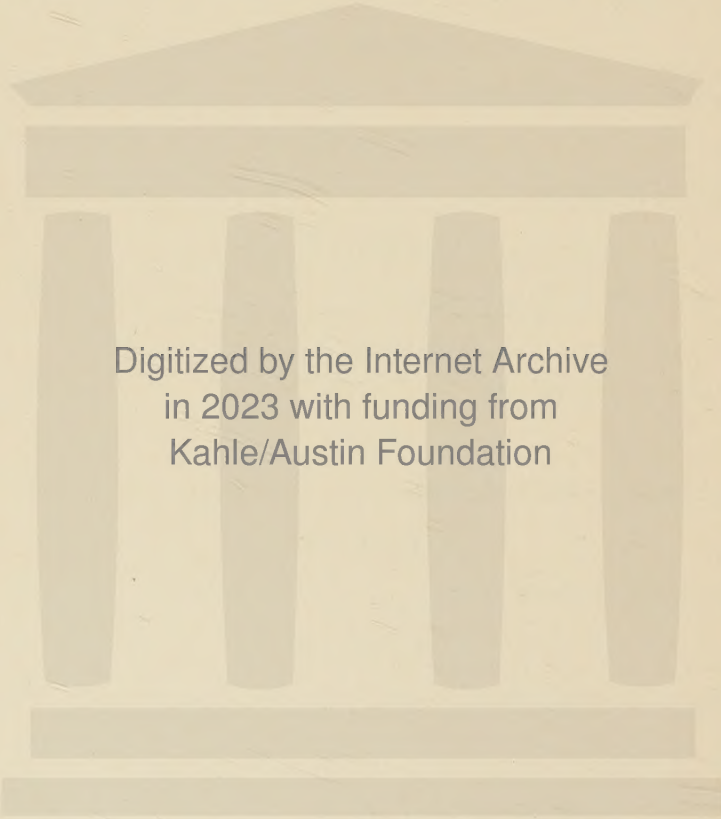
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INTRODUCTION

Dr. Sweeney's dissertation on "The Natural Increase of Mankind" is based on work for his Doctorate of Science in Hygiene done in the Department of Biometry and Vital Statistics under the direction of Professor Raymond Pearl in the School of Hygiene and Public Health of the Johns Hopkins University. Its publication has awaited for several months the preparation of the introduction which Dr. Sweeney kindly asked me to write.

Although the subject is somewhat remote from my own special studies, its bearings are so broad that it comes within the field of interest of every student of hygiene. Indeed no branch of inquiry surpasses the population question in the extent and the importance of its contacts with so great a variety of problems—biological, sanitary, economic, political, ethical and social—nor is any aspect of this question more important in its relation to national efficiency, prosperity and happiness and to great world issues of peace between nations, than the consideration of all that concerns the growth of population.

As Marshall in his "Principles of Economics" remarked thirty-five years ago, Malthus' "Essay on the Principle of Population," published in six editions¹ from 1798 to 1826 during his lifetime "is the starting point of all modern speculations on the subject" and "his work has the merit of being the first thorough application of the

¹ Each edition adds something of value to its predecessor, the second (1803) being virtually a new work, and the sixth (1826) being the accepted, authoritative final statement. The appendices to the third (1806) and the fifth (1817) editions are of especial importance.

inductive method to social sciences.”² After over a century and a quarter of criticism, accompanied by an amazing amount of abuse and misrepresentation, the reputation of Malthus is to-day higher, and the essential soundness of his fundamental thesis, when properly understood, is more generally recognized by authoritative biological and economic students of the population question than at any previous time.

Dr. Sweeney’s study of population growth is the most comprehensive world-wide survey of this subject made in recent years by application of a uniform statistical method, so far as available data permit. He is careful to point out the inadequate and unsatisfactory character of no small part of the statistical data, and the bearing of this imperfection upon inferences to be drawn from them. It is a source of profound regret and a reproach that our country has been so terribly backward in collecting the data, especially the birth-rates, requisite for such a study, although there is gratifying improvement in this regard within recent years. Contrast the situation of the United States with its incomplete and unsatisfactory registration of births for a decade or two in only a part, although fortunately a rapidly increasing part, of the country with the remarkably satisfactory

² Malthus stands in much the same relation to previous discussions and speculations on the population question as Darwin to the theory of evolution. The most remarkable anticipations of Malthus’ doctrine were those of the Scot, Robert Wallace, of the Irishman, Richard Cantillon, and of the Italian, Giammaria Ortes, most of whose writings were unknown to Malthus and indeed to the world in general until long after his day. Nor is it fair to Malthus to say, as some have done, that he shines merely by reflected glory through the acknowledgment by Darwin and by Wallace of their indebtedness to him. Not only was he the first to use the expression, “struggle for existence,” but he made fruitful application of this evolutionary principle to the study of human populations.

records of Sweden going back to 1748. An interesting deduction is drawn by the author regarding evidence for the incompleteness of registration of births and deaths from variability in the trends of birth-death ratios not otherwise explicable.

The most interesting and important feature of the statistical procedure employed by Dr. Sweeney is the use of the birth-death ratio in the form suggested in 1920 by Pearl and designated by him as "the vital index" $\frac{(100B)}{D}$, concerning which Pearl³ remarks: "It may fairly

be said that there is no other statistical constant which furnishes so adequate a picture as this of the net biologic status of a population as a whole at any given moment." In several publications he has called attention to this measure of evolutionary survival value as an index of biological soundness.

In the interesting chapter on "Declining Birth-Rates" and elsewhere the reader cannot fail to be impressed with the extraordinary misconception pointed out by Dr. Sweeney, as had already been done by Pearl and others, running through much of the popular literature, that a declining birth-rate of itself signifies reduction in the rate of increase of population. One of the important lessons from the collection of the means of the vital indices in successive years for the different countries is the correction of this prevalent misconception, which indeed Malthus in his day was at great pains to correct, as when he remarks: "It appears from the undoubted testimony of registers that a large proportion of marriages and births is by no means necessarily connected with a rapid increase of population, but is found in countries where it is either stationary or increasing

³ Introduction to Medical Biometry and Statistics. 1923, p. 168.

very slowly.”⁴ According to him the ratio of births to deaths in England in 1801 was about 4 to 3 (vital index 133).⁵

The birth-death ratio of course says nothing concerning the actual number of births or of deaths in ratio to the population, and it does not fall within the purpose or the scope of Dr. Sweeney’s study to make more than incidental reference to the highly important question of the relative advantages or disadvantages of population growth through high or low birth-rates with correspondingly high or low death rates, the two rates, although not of necessity connected, usually rising or falling together, although not necessarily at equal pace. Closely connected with this question are many important and difficult problems, all of which require much more careful and refined investigation, especially by quantitative methods, than they have yet received, in spite of their prominence in present-day discussions of the population question. Among these problems may be mentioned the selective value of mortality and morbidity rates, differential fertility, the distribution of births and deaths in different classes of the population and of the latter at different ages, the immediate and remote effects of humanitarian, medical and sanitary efforts as affecting the quantity and the quality of the population, the social significance of changes in age distribution of the population resulting from prolongation of the average duration of life.

The entrance of the biologist, and more especially within recent years of the geneticist concerned with the study of heredity, into the discussions of the population

⁴ Malthus. *An Essay on the Principle of Population*. 3rd Ed., London, 1806, Vol. II, p. 510.

⁵ *Op. cit.* II, p. 535.

question has greatly stimulated interest in such problems as those just mentioned, the importance of which can hardly be overestimated. A further incentive of a quite different kind in arousing interest in this field has been the supposed interference to a marked degree with the process of natural selection by the remarkable triumphs of modern medical and public health efforts, especially since the beginning of the present century in the reduction of infant mortality.

Although the question of high or low birth-rates in relation to the growth of population is only indirectly concerned in the consideration of Dr. Sweeney's essay, I cannot refrain on account of their historical interest from quoting the views of Malthus on this subject:

"In many parts of the Essay," says Malthus, "I have dwelt much on the advantage of raising the requisite population of any country from the smallest number of births. I have stated expressly that a decrease of mortality at all ages is what we ought chiefly to aim at; and as the best criterion of happiness and a good government, instead of the largeness of the proportion of births, which was the usual mode of judging, I have proposed the smallness of the population dying under the age of puberty." In a foot-note he adds: "It should be remarked that a young person saved from death is more likely to contribute to the creation of fresh resources than another birth. It is a great loss of labor and food to begin over again. And universally it is true that under similar circumstances that article will come cheapest to market which is accompanied by fewest failures!"⁶

⁶ Op. cit. II, p. 513 et seq. The latter part of the quotation is reminiscent of the Ricardian or "classical" school of economists, with whom Malthus is usually classified, but it is to be noted that Roscher claims him as a pioneer of the "historical" or inductive school. The truth is of course that the survival of Malthus' doctrine amid the wreck of so much economic theory is due to its firm support by the facts of life, upon which it was founded. The predictions of Malthus and his "prudential check" should not be confounded with his "principle" of population.

It will be observed that the line of argument of this keen thinker is here concerned solely with the question of quantity and of economic waste, and not at all with that of quality which enters so largely into discussions of the subject since the work of Darwin, of Galton, of Mendel, and of Morgan.

Parenthetically in this connection it may be remarked that unless he had radically changed his opinions (and it is quite possible that he might have done so) Malthus would not have joined any of the modern Malthusian leagues, or have permitted the use of his name to designate what is now called "neomalthusianism," however much these movements may seem to be logical deductions from his principles. Although there is evidence that he did not himself have overmuch confidence in the effective operation of his "preventive" or "prudential check" by postponement of marriage and by pre-nuptial self-restraint, he never approved contraceptive methods, of which comparatively little was known at that time. In the appendix to the fifth edition of his "Essay" he vigorously resents the charge that he had ever done so, saying: "I should always reprobate any artificial and unnatural modes of checking population, both on account of their immorality and their tendency to remove a necessary stimulus to industry." He attached great importance to moral and religious impulses in restraining egoistic tendencies, and stressed the prospect of marriage, not to be contracted until there is adequate means of support of a family, as a powerful stimulus to industry. It need hardly be said that, besides the difficult moral questions, the physiological and psychological aspects of the question were little understood at the time Malthus wrote. On account of misapprehensions which have prevailed ever since Malthus' first publication, it is only

just that there should be a clear understanding as to what he meant by the "preventive check."⁷ Probably the following statement by Professor Carver would be in line with the thought of Malthus. After pointing out the beneficent influence of a sound educational system and a selective immigration policy on the distribution of talent and of wealth in the population he continues: "but the problem of increasing the birth-rate among the intellectual classes and decreasing it among the unskilled and ignorant classes seems well nigh insoluble. Probably nothing except a superior kind of moral teaching, which will increase the family-building ambition and diminish the spawning tendency is the only effective remedy."⁸

Without entering upon a discussion of the selective values of birth-rates and of death-rates, concerning which much misapprehension exists and much more exact knowledge is needed, I shall only remark in this connection that their control by man is only a part, although a very important part, of his ever increasing control over nature, and that, whatever the penalties, it is certain that "Nature's insurgent son," to use Ray Lankester's expression, will always continue to rebel against "Nature's inexorable discipline of death," and will never cease his endeavors to postpone the execution of her inevitable decrees, as he has already done with no small measure of success. Let the medical man and the sanitarian seek and advance knowledge of these important questions, but for both there is in this matter no safe principle of conduct other than the preservation of human life from the time of its conception. To extend

⁷ A distinguished English sanitarian once told me that there is occasionally some hesitation in England in using the term "preventive medicine" as a synonym of "public health" on account of certain implications popularly attaching to the epithet "preventive."

⁸ *Encyclopedia Americana*, 1920, Article "Wages," vol. xxxiii, p. 208.

this protection, as apparently some opponents of certain modern tendencies would do, to the unyoked germ cells is the height of absurdity.

The reader will be much interested and perhaps surprised by the statistical results recorded in the chapter on "The Effect of War and Pestilence," which confirm the conclusion already reached by Pearl of the very transitory retarding influence of the World War and the influenza epidemic of 1918 upon the onward march of population growth. It would seem desirable, if the material were available, to make a more extended survey of the effects of wars on population in view of Roscher's conclusion half a century ago that these effects depend less upon the destruction of life than upon "diminution of the sources of the means of support" of the population. He finds that some wars may be accompanied by even more rapid growth of population.⁹

Much interest attaches to the evidence presented by Dr. Sweeney concerning the distribution of the varying vital indices in accordance with their magnitudes and slope values in relation to the geographical location of the countries studied, as well as in relation to many other factors, as migration, agricultural and industrial development, previous magnitude and trend of the index, social and racial differences, etc.

The author's most important conclusion, however, is in accord with that reached by many other students of the population question, particularly during and since the world war, that several western European countries, France being a unique exception in many respects, as well as China, India and Japan, are already suffering from over-population, and that for a number of other

⁹ Roscher. *Principles of Political Economy*. Translated by John J. Lalor. Chicago. Vol. II, p. 281 et seq.

countries the outlook in the not distant future is ominous. In other words the author holds that the question of over-population is a world problem deserving already the most serious consideration and likely to become within the next half-century or century for many parts of the world a problem of the most pressing importance. He finds that the action of existing regulatory checks has "served in no way to insure safety as regards the consequences of excess numbers," and he can see no remedy except the further extension of voluntary restriction of births.

As is well known, opinion is divided upon both of these questions—the menace of over-population and the remedy through birth-control. There is undoubtedly a self-regulatory mechanism influencing the numbers of the population in relation to means of subsistence and standards of living, and unquestionably more knowledge is needed concerning the nature and operation of these regulatory factors. Over-population has become a world problem not because the world as a whole is over-populated, for it is far from that, but on account of the situation and importance of the areas where local surpluses of people exist and on account of the very unequal distribution and control among the different countries of scantily occupied or uncivilized parts of the world rich in undeveloped resources. Past experience shows that it is very hazardous to make predictions of the possibilities of increase in the power of the world to supply the requirements of man. Whatever allowance should be made for such modifying considerations as these no one should be oblivious to the force of accumulating evidence tending to support the position taken by the author in company with many other recent investigators of the population question.

Dr. Sweeney's pessimistic conclusion of his essay that the presentation of the facts which he has assembled and of his views will not influence the course of events strikingly resembles that of East in closing his able and vigorous book, "Mankind at the Crossroads," which covers in a popular way a much wider range of facts and opinions on the population question than does the present work:

"One should," says East, "be under no illusion as to what is likely to be the immediate fate of a social scheme which requires an appreciative forethought by whole peoples, and not merely acceptance by the intelligentsia. No matter how much suffering could be prevented, no matter how much greater a civilization could be built by its application, its general adoption will probably await the compelling force of economic necessity."

Malthus was strong for spreading knowledge of the principles of population. With an optimism not justified by later experience he said: "It must be highly advantageous that they should be known to all those who have it in their power to influence the laws and institutions of society."

In spite of modern tendencies apparently to set no limit to the extension of state control over individual liberty it is probable that Dr. Sweeney is equally under no illusion regarding the feasibility of his suggestion of a "league of stationary populations," or Harold Cox regarding his proposal of a "league of low birth-rate," or East as to a "voluntarily standardized population." The fundamental conception underlying these and similar suggestions is not new. As Marshall in his "Principles of Economics"¹⁰ points out: "Aristotle objects to Plato's scheme for equalizing property and abolishing poverty on the ground that it would be unworkable

¹⁰ 2nd Edition, London, 1891, Vol. I, p. 230.

unless the State exercised a firm control over the growth of numbers. And as Professor Jowett points out Plato himself was aware of this."¹¹ The views of the Greek social philosophers on regulation of numbers as an important concern of governments are succinctly summarized by Ingram as follows:

"Like other Greek social philosophers Aristotle recommends to the care of governments the preservation of a due proportion between the extent of the civic territory and its population, and relies on pre-nuptial continence, late marriages and the prevention or destruction of births for the due limitation of the number of citizens, the insufficiency of the latter being dangerous to the independence and its superabundance to the tranquillity and good order of the State."¹²

It need hardly be said that modern States have been much more concerned with stimulating than with retarding the growth of population.

It is not necessary to accept all the gloomy forecasts

¹¹ As is well known, Malthus first took up the study of population as a polemic against the theories of Godwin, derived from Rousseau, Condorcet, and other French thinkers, concerning the perfectibility of mankind under an ideal social system. It is interesting to note that in contrast to Malthus' conservative application of the principle the Benthamites or utilitarian philosophic radicals applied it in a contrary sense as is pointed out by John Stuart Mill in his "Autobiography," where he says: "Malthus's population principle was quite as much a banner, and point of union among us, as any opinion specially belonging to Bentham. This great doctrine, originally brought forward as an argument against the indefinite improvability of human affairs, we took up with ardent zeal in the contrary sense, as indicating the sole means of realizing that improvability by securing full employment at high wages to the whole labouring population through a voluntary restriction of their numbers." In another connection he notes that opponents of this school denounced "anti-population doctrines as repulsive to the natural feelings of mankind," and admits that "the cultivation of feeling (except the feelings of public and private duty) was not in much esteem among us" ("Autobiography," New York, 1874, pp. 105 and 111).

¹² J. K. Ingram. Article "Political Economy" in the 9th Edition of the *Encyclopaedia Britannica*, vol. xix, p. 350.

of "over-populationists," or to adopt their remedies in toto, or to agree with all of their deductions from ascertained facts concerning the future growth of population or concerning the possibilities of increased production of wealth and of food, or even to await much needed new knowledge in order to realize that enough is already known of the existing situation and the immediate outlook to call halt to the easy, superficial optimism which prevailed during the last century regarding the population question, largely as a result of the rapid industrial development, the opening of new sources of supply of food, and improved means of transportation—factors, especially food production, which in large areas of the world are already experiencing in increasing measure the operation of the economic law of diminishing returns.

The possibilities of further international complications and conflicts traceable more or less directly to excess of population, and the close relationship of the subject of population to questions of national security, disarmament, militarism, imperialism, nationalism, immigration, rivalry for control of markets and essential supplies, unemployment, poverty and disease are too apparent to justify continued indifference on the part of governments and peoples to questions of population, however difficult and insoluble many of these problems may now seem to be. The least that the situation demands is some general recognition of the immediate and future dangers, and some intelligent study of the subject by those in authority or in position to influence governmental policies and public opinion. Considerations such as those mentioned and other relevant ones affecting the prosperity of nations and the peace of the world call urgently for that serious international study and conference and that helpful international coöperation and

adjustment for which the League of Nations with its trained secretariat and its organized system of conferences between representatives of governments is the only agency existing today or likely to be created either qualified or empowered to act with any measure or promise of success.

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CHAPTER I

THE PROBLEM

Probably no other one subject has received the attention of such a varied group of writers and thinkers as that of the population question with all of its component factors. Since the epochal essays of Malthus, which incidentally were not the first writings upon this question, men's minds in virtually every country have been directed toward the discussion and analysis of the problem. Even though some writers today question the importance of this problem a review of the literature, leaves no doubt in one's mind that it is generally regarded as one of the most vital problems confronting man today. Those who doubt its gravity and feel that much unnecessary concern is being aroused appear to be in the minority.

As the population problem is directly a result of the ever increasing number of people, and as this increasing number is ultimately the result of the natural, normal reproductive process (excess of births over deaths), all methods of approach to the problem must of necessity involve births and deaths. Many measures and indices involving these two phenomena have been proposed to show the status of the various populations. As the title of this study suggests, its purpose is to examine the various populations as to their natural increases and to present a comparative picture of them. A brief discussion, therefore, of some of the measures which have been suggested for this purpose may first be given.

Perhaps the commonest method—and the most obvious one—of showing natural increase is the actual excess of births over deaths, or if expressed by a ratio, the excess

percent or rate of births over deaths. Such methods have in general meant only to indicate the rapidity with which a population is growing. They have been used in many writings to show the comparative status of different populations. Some writers have gone farther and have used either the birth-rate or the death-rate or both, as a measure of civilization. Sundbärg (1), for example, proposed simply the death-rate as a "measure of civilization." Rubin (2) objected to Sundbärg's technic, contending that the deaths are not adequate for such a measure inasmuch as the "two most active instincts in all living things are those of self-preservation and reproduction." He proposes in its stead D^2/B (where D = deaths and B = births) as the measure of civilization except where the death-rate and birth-rate are in the same proportion, in which case the former becomes the measure. Sundbärg (3) in turn objects to the above proposal because of the difficulty of deciding the true influence belonging to B . He suggests, however, if it be taken as an index, that D/\sqrt{B} is preferable. Sundbärg adheres finally, nevertheless, to his original D .

Another measure which has been used to a surprisingly small extent as a measure of the condition of a population, is the simple ratio of birth/deaths, of course within a given time. Brown (4) in 1868 used this ratio in a study of the population of the European countries. It does not, however, appear to have been adequately discussed since the writing of Wernicke (5) in 1889, and his use of it was not the most effective. This measure appears now and then in the literature but does not seem to be used to its greatest advantage.

The term "vital index" as a designation of the B/D (birth/death) ratio of a population was suggested by Pearl (6) in 1920. In a paper published subsequently by the

same writer (7) the vital index is defined as a term "to designate that measure of a population's condition which is given by the ratio of B to D within a given time." Regarding the measure, he adds: "It may fairly be said that there is no other statistical constant which furnishes so adequate a picture as this of the net biological status of a population as a whole at any given moment. If the ratio $100 B/D$ is greater than 100, the population is in a growing and in so far healthy condition. If it is less than 100, the population is biologically unhealthy. Depopulation may not be actually occurring, if there is a sufficient amount of immigration to make up the deficiency in births. But fundamentally and innately the condition is not a sound one from a biological standpoint, though under certain circumstances, it may be from a social standpoint."

In 1921, Pell (8) wrote upon the relation between births and deaths, and held that the reproductive capacity of a species should diminish as the survival capacity of the organism increases. In other words, he believes that the birth-rate in man is controlled by a natural law. His beliefs have not been generally accepted as yet.

Thus it is seen that various methods have been used to show the trends and status of populations. One is perhaps as good as another for showing whether or not births predominate over deaths and whether or not a population is actually increasing naturally. To call such a term a "measure of civilization," however, seems to the writer to be ascribing too much importance to the phenomena of births and deaths in this connection. What is meant by civilization? Do a large number of births and a small number of deaths in a given population give a measure of civilization? Until there is a commonly accepted definition of civilization it seems there will always be an

opportunity for controversy regarding its measure. If the population problem is a real problem, if there is an ultimate danger of over-population, if man is doomed to procreate himself until the positive checks of nature must operate, should not a population presenting a low birth-rate with a correspondingly low death-rate (in other words, a stationary population) be regarded as high in the scale of civilization? Civilization seems to have been regarded as the expression of man's ability to procreate and to preserve. Again, is this an expression of civilization? Can one say on this basis that rural communities are more "civilized" than urban? And does a country's death-rate, per se, measure its civilization? Disease is believed to have been unknown to primitive man (9). Barring combats and accidents his death was from natural exhaustion of one or more of his organ systems. This being true, can one say that primitive man was more civilized than his present progeny? It is realized that the last question is perhaps an absurd one, but it serves to show that civilization is in itself only a relative thing. And due to its complexity it is incapable of being measured by any simple ratios unless certain phases of it are ignored or considered unimportant. For example, such a measure as a ratio of births to deaths or simply deaths carries not the slightest implication of quality. Is the quality of a population's increase important in its civilization? "Civilization tends now, as always, to a weeding-out of the best," writes Dean Inge (10). Therefore, can any ratio that ignores quality be a "measure of civilization"? It is admitted that what is good quality and what is bad quality may be controversial, but it is felt that at least there is a *general* agreement in this respect, certainly within broad limits. Finally, one may regard as a measure of civilization man's ability

to harness or effectively use natural powers for his own benefit, either as a luxury or as a necessity. In fact, would not most individuals if asked what measures civilization, say that it is man's progress in the utilization of natural powers? The use of the radio, the progress of hydraulic engineering, etc., might well be mentioned as indications of advanced civilization. Such achievements are not necessarily positively correlated with man's procreative and preservative index, as is obvious; and yet they are, in a sensible way, measures of civilization. Therefore, would it not be more accurate to find another appellation for the measure of a population's status as expressed by some relation between births and deaths? "Measure of civilization" is objected to merely because of the vagueness and indefinability of the term. Even to define civilization is, from the standpoint of universal agreement, almost if not entirely impossible.

The term "vital index" for the ratio $100 B/D$ seems to be less ambitious in its connotation. Its author, Pearl (7), however, lays much stress upon it as a measure of the biological soundness of a population. Let us analyse the measure and determine just what its true meaning is. The birth-rates in practically every country are known to be declining. It is believed by most writers that the practice of voluntary restriction of births is the principal means of lowering the birth-rates. Finally it is thought that ultimately economic influences are responsible for the employment of birth control measures. Likewise the death-rates are decreasing in most countries, brought about by causes not all of which are of biologic nature. Therefore it may be argued: If the birth-death ratio is capable of being affected by economic and other factors, is it a true measure of the biological soundness of a population? Does it not really measure the

effect of a multiplicity of factors, principally economic, upon the phenomena of births and deaths? Such an argument is well taken but it is inadequate. Man is ultimately responsible for all environmental changes (excepting of course natural environmental changes), whether they be economic, sociologic, or what not. Such changes are products of man's activities, of his evolution. In this sense economic factors are biological factors. They are but environmental elements in the whole biological complex. Thus if the ratio $100 B/D$ of a population in any given moment of time is less than 100, it means that that population is under reproducing itself (whatever the cause may be) and that decay is taking place. It means further that if such a status continues within any population, ultimate actual extinction is inevitable. This is but another way of saying that such a population is biologically unsound or unhealthy.

Now what is the real biological meaning of the vital index? What does it actually measure? It measures always the *present worth of the evolutionary survival value of a population*, but implies *nothing* as to how this present worth is brought about. Furthermore, the vital index implies nothing intrinsic in a population. For example, it does not necessarily measure the innate fertility of a population. To be a true measure in this sense there must be a well-defined inheritance of fertility within a race and this does not appear to be the case. As Pearson (11) has said, "I am only in a position to say that I have not, hitherto, been able to find a *marked* inheritance of fertility *within the race*, and begin to doubt its existence. . . . The slight intensity of the inheritance of fertility such as we find intraracially in man and other mammals is quite compatible with its being only indirectly transferred because it is correlated with directly

inherited characters." Further evidence is that certain races under one environment are relatively infertile, while the same races in another environment are extremely prolific. As pointed out in the "Bulletin de la Statistique Générale de la France" (12), the population of Quebec has quadrupled in eighty years (1831 to 1911) and of the 2,000,000 inhabitants in the latter year, 80.5 per cent were of French origin. Everyone is familiar with the nearly stationary population of France and no further comment is here necessary. Also Foerster (13) has shown how prolific the Italians are in the Argentine; how, as a result partly of their rates of reproduction, they comprise possibly one-third of the population in that country. This fertility appears to be higher than that manifested in Italy where there is only an average of 135 births to every 100 deaths. Further, all the Australian states possess mean indices above 200 (over twice as many births as deaths) which are far greater than those of their mother stock, which stock, according to Knibbs, Commonwealth Statistician (14), is chiefly British.

Thus we may say that the vital index ($100 B/D$) measures nothing intrinsic in populations unless it be an inherent proclivity to react in certain ways and in different degrees to certain environmental conditions. The birth-death ratio measures only the natural increase—and might well be called a *natural growth index*—but as indicated above, implicit in the ratio is a measure that defines the biological soundness of a race in so far as its survival under existing conditions is concerned. Or, putting it in another way, the vital index measures the present status or value of a population in the sense of organic evolution (its present survival value) in exactly the same way and with the same precision that a ticker quotation measures the present value of United States

Steel or any other stock. In this sense, the adjective "vital" applied to the index has a specific connotation.

The specific purpose of this study may now be stated. Keeping in mind just what the birth-death ratio ($100 B/D$) measures, this study simply proposes to present a perspective of the biological status of the populations of the various countries, states and territories, as indicated by their vital indices. In such a picture we can see which peoples are numerically leading in their contributions to this world of humanity; we can see the comparative rapidity with which the populations are increasing or decreasing; and we can see the relative biological healthiness of the races of man, and may even predict—if we do it silently—those races that in the years to come may be contenders for supremacy in peopling the earth. Just what the future of man today is lies beyond the limits of his imaginings. There are many who refuse to be concerned over posterity, believing in an automatic adjustment of all possible troubles numbers may provoke. There are those who think that the course of populations is too complex to be resumed in any simple law; as, for example, Willcox (15) who is inclined to believe in the adjustment, automatic or otherwise, to an optimum number, as described by Carr-Saunders (9). It seems to the writer that such views are inconsistent with facts. Upon what does man ever base his behavior? Always upon past experience; he has nothing else. And what does our past experience reveal to us? It reveals an ever increasing mass of humanity.¹ Have we any right to say that

¹ Carr-Saunders (9) points out evidence to the effect that primitive races maintained an optimum number in their populations by various means, some of which are considered by man today as criminal. Can one predict that man now will, without conscious and concerted action, acquire such a practice? And such a practice surely cannot become a reality without such action.

this rising tide of numbers is automatically going to adjust itself to any optimum—quietly and without damage to mankind? The only indicators we have for action are the past and present trends of population. No one can deny that a population in a given area, *can*, without access to outside resources, reach a numerical size which is detrimental to decent progress—social and physical—and which is inhibitive in an undesirable fashion to further growth. As Pearl (16) has pointed out, we have no other world to go to for outside resources. Some parts of the earth now are at least relatively over-populated; for example, India and China, in which places there would undoubtedly be less wastage of human life if there were fewer people. So is it not wise, rather than trust to the unknown future to regulate, at least to be concerned and to be prepared with a possible solution for the problem, if within the coming years there is no evidence of its being naturally and satisfactorily solved?

It is felt, therefore, that a picture of the comparative status and trends of the various populations is desirable and will be of interest; and it is hoped it may be of value. Before the figures are presented, however, it will probably be interesting as well as helpful to a fuller appreciation of the population question in general, to note briefly some of the various opinions that have been expressed regarding it. Further, as the problem is fundamentally dependent upon the phenomena of births and deaths and as there has been so much written upon the declining birth-rate and its relation to the future of populations, it is believed that the inclusion of the various ideas which have been expressed upon this subject is justifiable.

CHAPTER II

THE DECLINING BIRTH-RATE

Most of the earlier writings relating to population dealt largely with the quantitative aspects. In the later writings, however, one finds an increasing interest in the qualitative aspect as would, of course, be expected. The English and French appear to have been the most prolific writers on the different phases of the subject. In fact, in both countries commissions have been appointed for the purpose of studying the declining birth-rates in an effort to determine the possible causes; and in France the declining population has been a subject of much study. The latter country has been the subject of many writers because of her unique population status. The precarious position now held by France has been applied to other populations; analogies have been drawn and predictions have been made. Some authors, as we shall see, predict extinction for the race, while other writers are convinced that France's position is no cause for alarm. Widely divergent opinions have been expressed regarding the declining birth-rate phenomenon, its causes and possible effects. Again some writers are staunchly opposed to a low birth-rate, while others proclaim that it should be encouraged. The greatest concern in more recent years has been manifested over the differential fertility rates prevailing in most countries. This phenomenon apparently is becoming more and more marked. The so-called upper classes are not reproducing themselves as fully as the lower classes; and upon this question we find the eugenicists vigorously pointing out the ultimate destruction of the present civilization unless something is done to check the trend.

In the résumé to follow, due to the inter-relationship of all the factors mentioned above, there will be no attempt made to deal separately with them. The declining birth-rate will be considered the principal thesis, therefore, around which an attempt will be made to summarize some of the many opinions with all of their attendant implications.

As previously mentioned there is some disagreement as to the cause of the declining birth-rates, and we find in general three views held by various writers. One view which has perhaps the greatest number of supporters is that the cause is to be found in the use of contraceptives, or the practice of birth control. The second view is that the declining birth-rates are caused by economic factors. The third view, which is supported by but few writers, is that birth-rates present cyclical variations and that the present declines are but downward trends of a wave. It appears to the writer that the first two views are basically one and the same, the first being really but an expression of the influence of the economic factors. As Yule (17) has said, contraceptive methods are a means of lowering a birth-rate and not a cause. This point can be better shown by noting the conclusions reached by Newsholme and Stevenson (18) in their study on "The Decline of Human Fertility in the United Kingdom and Other Countries as Shown by Corrected Birth-Rates," and by Yule (19) from his study "On the Changes in the Marriage and Birth-Rates in England and Wales During the Past Half Century," and by the discussion that followed the reading of the two papers.

The general conclusions of Newsholme and Stevenson were as follows: "The decline of the birth-rate is not due to increased poverty. . . . It is associated with a general raising of the standard of comfort, and is an ex-

pression of the determination of the people to secure this greater comfort. . . . It is not caused by greater stress in modern life, but is a consequence of the greater desire for luxury." Factors mentioned by these writers as possibly aiding the decline are the raising of the age of leaving school and allied changes as to work; the gradual slackening of religious restraints; and the gathering of a large population in towns which gives facilities for the communication of information on the subject of birth control and makes possible the purchase of necessary appliances. The authors add in conclusion: "We have no hope that any nation—in the absence of strong and overwhelming moral influences to the contrary—will be permanently left behind in this race to decimate the race. We must look—failing the possibility indicated in the last sentence—for an increasing practice of artificial prevention of child-bearing, which, whatever may be said for exceptional instances, is at least difficult to justify when used merely as a supposed means towards increased social comfort."

Yule concludes "that the course of prices has been in some way, directly or indirectly, an important factor in the changes that have taken place in the reproductivity of the race, or an index to such a factor. To say this is of course in no way to exclude the concomitant action of other influences, and it has in fact been pointed out that some other causes—possibly a pressure on the labour market, due to the high birth-rates preceding 1876, and the lower death-rates since—has in fact contributed to force both marriage- and birth-rates lower during the past fifteen to twenty years than the course of prices would lead one to expect."

Referring to Yule's paper, Newsholme remarked that "it was remarkable that the same enormous decline, only in varying degrees, had occurred in different countries in

which the economic conditions had been very different.”¹ Yule replied that it “was precisely the extraordinary similarity of the change in very widely different countries that made it difficult for him to accept the purely moral theory—the theory of change in “moral tone.” . . . and if there had been that change in moral tone for which Newsholme and others argued, he was still inclined to regard economic factors of some kind as lying behind it. . . . If there had been a change in “moral tone,” but one brought about by economic factors, the question arose whether there was any real distinction between the two views as expressed by Dr. Newsholme and Dr. Stevenson’s paper and his own.”²

Can it not be said then that the changes in the individual which bring about the change in “moral tone” are traceable ultimately to economic causes? When Newsholme and Stevenson conclude that “the decline of the birth-rate is not due to increased poverty” have they not overlooked the fact that the individuals desired social comfort? Otherwise, perhaps there would have been no decrease in the birth-rate. Newsholme and Stevenson’s second conclusion states that the declining birth-rate is associated with a general raising of the standard of living. Now, if there were no economic checks could not individuals have large families and still maintain a high standard of living? It seems reasonable to state the case as follows: The declining birth-rate, as far as our evidence goes, is in the main produced by the practice of birth control, and is an expression fundamentally and ultimately of economic influences.

The third view is held, as Elderton (20) puts it, by only one first rank statistician. Elderton concludes in her

¹ Loc. cit., p. 31.

² Loc. cit., p. 31.

study that the declining birth-rate is not due to any physiological decrease in fertility, but to a widespread voluntary restriction. Dr. Brownlee (Proc. Roy. Philos. Soc. Glasgow, April 29, 1908), as she points out, is the only first rank statistician who holds a contrary idea. That his view has only a few supporters is shown by Chalmers (21) who writes: "Considering that the whole function of reproduction is physiological and vital, and only incidentally influenced by food and environment, it is surprising that only two witnesses were found to support the suggestion that some part of the declining birth-rate might be attributed to cyclical variation in the power to procreate or conceive." He goes on to say that "we have seasonal and cyclical variations in disease, and in almost every form of vital activity we are acquainted with, there are periods of activity and repose," and adds that similar variations in fertility should not seem improbable. He then gives the conclusion of Brownlee (Public Health, June and July, 1916) who points out that centering about the years 1600 and 1800 high birth-rates existed in England and Wales as a whole, and that during the intervening period about 1700 the birth-rate was lower, which is the same phenomenon that is observed today. He (Brownlee) believes "that a considerable part of this oscillation in the birth-rate is an expression of race physiology." Unfortunately, with the statistics that are available, this contention is incapable of being proved or disproved. The weight of opinion, however, seems to be against it.

There is one other observation which has been made and offered as a possible explanation and which should be mentioned. The Danish writer, Sören Hansen (22), draws attention to the question of relative inferiority of the first-born. Investigations along this line tend to show that there is a relative preponderance of morbidity

among the first two or three children born. Hansen's material bears this out especially in regard to feeble-mindedness and tuberculosis. He thinks it possible, in view of the weight of the earlier born being less than that of the later born (up to the fifth or sixth birth), that the circulatory mechanism of the female reproductive organs is not sufficiently developed during the first or even second pregnancy, and suggests that the consequent in-nutrition and arrest of fetal development may explain the phenomenon of inferiority. It is indeed conceivable that such factors could materially affect a birth-rate over a long period of time. As to just what influence they may be having on the present declining birth-rates, it is impossible even to hazard a guess.

It would be superfluous to quote individually the numerous writers' opinions on the declining birth-rate in this study. The views that have been cited comprise the outstanding ideas, and the mass of literature on the subject is not essentially different in context from that which has been mentioned regarding the causes of the declining birth-rates. The next step is to summarize the numerous views of the possible effects of the phenomenon. These are principally of a qualitative nature, although some writers treat only the quantitative aspect. So in the following résumé the qualitative phase will be regarded as the principal thesis.

Again we find that the British and French writers have been most concerned over the qualitative phase of the declining birth-rates. The former especially have attacked it from a eugenical standpoint. The concern has arisen mainly from the fact that in the declining birth-rate in England, the so-called upper classes show on the whole a greater decrease than the lower classes (23). This phenomenon appears to be universal wherever a declining

birth-rate prevails, which is in practically every country. To the eugenists especially the outlook is gloomy. Should the differential fertility persist it means extinction to the upper classes, naturally or by force of being literally outnumbered.

The well-known leader of eugenists in England, Major Leonard Darwin (24), makes the interesting observation "that the well-paid and naturally efficient will continually keep mating with the well-paid and naturally infertile; and that by the mingling of these streams, natural efficiency will as the generations succeed each other come to be slowly but increasingly correlated with natural infertility." He adds that a continuous increase in numbers will in all probability lead to a lowering of the standards of life; "and as most authorities agree that, taking the world as a whole, agriculture has now reached or is nearly approaching the condition of diminishing returns, does it not follow that any continuous increase in the population would sooner or later result in a lowering of the standards of life?" Regarding the possible safeguards against such a tendency he continues: "As there always has been and always will be a widespread and praiseworthy desire to help all young children, this will ever lead to a demand for the removal of all those financial strains falling upon parents which result from a proper care of the children. These demands will generally be made without its being perceived that these financial burdens on parents constitute the most effective existing check on fertility, and in ignorance of the harmful consequences which their removal would probably produce by increasing the distress due to over-population." He predicts in conclusion that the problem will become more and more important along with the evergrowing democratic sentiment, and says: "To those who like myself have come to the

conclusion that the tendency of the financial pressure of poverty to reduce fertility ought not be combated but rather promoted, it is of little use merely pointing out the drawbacks to all such schemes, for they stare us in the face. We long to find other efficient methods of safeguarding the nation against deterioration, and to produce a better scheme would be the only reply we should regard as effective."

In another article this eugenist (25) says "that average excessive poverty must be accepted in this country in some degree as a test of the average unfitness of a class, and, moreover, that destitution is likely to become a more and more reliable criterion of innate inferiority as time goes on." In still another place he (26) writes: "If the dangers of racial deterioration consequent on the fall in the birth-rate amongst the educated classes are contrasted with the immediate dangers of over-population due to the advocacy of the more rapid multiplication of the fit, it seems that an increase in the fertility of the fit should be vigorously demanded; whilst a decrease in the fertility of the unfit is to be advocated strongly on both racial and immediate social grounds." Finally from the pen of Darwin (27) comes the statement: "If the Government were to adopt adequate measures affecting fertility in good homes and in bad, the doors of hope would be thrown wide open, disclosing a prospect before us of indefinite advancement in human welfare."

Dean Inge (28) forecasts a still more pessimistic future. He says it may mean racial extinction since he notes that a ruling race always rules itself out. He believes that eugenics may save the situation if there can be some scheme devised which will direct social forces to the improvement of the human stock and not to its deterioration as is now the case.

In the "Second Report of the National Birth-Rate Commission" (29) it is shown that the most serious cause of the fall in the birth-rate is the increase in the practice of birth control. The evidence shows that the methods are almost universally used by the income-tax paying class but not used by the reckless poor; and that the low infant mortality rate of the rich does not compensate for their lower birth-rate, so that the population is on the whole recruited from the less fit members of society.

Another English writer, Cox (30), contends "that it is impossible appreciably to raise the physical and intellectual standards of the mass of our people so long as the present conditions of life continue, and I further contend that the only practicable method of greatly improving present conditions is to reduce the population." Speaking of the phenomenon of differential fertility, he says: "In the upper and middle classes men and women assume as a matter of course that they have no right to bring children into the world except under conditions which will give those children a fair chance of healthy life. Why should the poorer classes be assumed to have the right to claim exemption from this moral obligation? A man has no right merely because he is poor to inflict upon his wife the needless suffering of bringing into the world a child that is doomed to die before it has ceased to be a child. Nor has man, merely because he is poor, the right to saddle his fellow citizens with the cost of maintaining children of his that nobody wants—not even their own mother." Regarding social endeavors he adds: "In recent years instead of insisting that parents must provide for the wants of their children, or suffer inconvenience and dishonor if they fail to do so, we have organized a system by which self-supporting and self-respecting parents are taxed in order to maintain the unwanted chil-

dren of improvident classes. In acting thus the State gives a premium to animal carelessness and lays a penalty on human prudence." The same writer, in his book—"The Problem of Population" (31)—after discussing the possible consequences of over-population, says that the best guarantee for future peace would be a "League of Low Birth-Rates" among European nations.

In a review of Dean Inge's second volume of "Outspoken Essays," Bertrand Russell (32) staunchly advocates socialism as a remedy for the present trend of society. He asks: "Is it not obvious, however, that the trouble comes from snobbery, from the desire to establish oneself and one's children as high as possible on the social ladder? There is much that is valid in the arguments of eugenists as to the biological evils of our present system. But it is strange that they do not perceive the only possible remedy for these evils; namely, socialism; so long as inheritance and social inequality persist, they cannot be remedied." A few years earlier Russell (33) advocated some radical changes, stating that "the present state of the law, and public opinion, and our economic system is tending to decrease the quality of the race, by making the worst half of the population the parents of more than half of the next generations." Speaking of the institution of a new system, he said it "must be based upon the fact that to produce children is a service to the State, and ought not to expose parents to heavy pecuniary penalties. It will have to recognize that neither the law nor public opinion should concern itself with the private relations of men and women, except where children are concerned. It ought to remove the inducements to make relations clandestine and childless. It ought to admit that although lifelong monogamy is best when it is successful, the increasing complexity of our

needs makes it increasingly often a failure for which divorce is the best preventive."

S. J. Holmes (34) points out that further restriction of the birth-rate must sooner or later come in the more civilized countries and notes that if this should occur mainly in the people of "better endowment, who already have a low birth-rate, the deterioration of our racial inheritance will go on at an accelerated pace." He makes the interesting observation, however, that "the third estate continues to include many people of excellent hereditary qualities" but pertinently adds that "in course of time they tend to rise and become sterile," and that "thus the great breeding ground from which they emerged is impoverished."

To quote again the Dean of St. Paul's (35): "Nothing fails like success, and the ruling people rule themselves out." In discussing the probable future he says: "Likewise the upper and middle classes of today in England will probably disappear in favor of the aristocracy of labor of which we are now witnessing the creation. They, in their turn, will exploit the public for their own profit. Further, it is likely that when they have consumed the surplus wealth of the community they will repudiate the burden of maintaining the proletariat."

Drysdale (36) argues that neither a rapid increase of population nor a high standard of national efficiency is secured by a high birth-rate. He holds that a high birth-rate means a high death-rate, and that if this is checked by humanitarian legislation it results in a "process of reversed selection." He advocates the limitation of families especially among the poorer classes and cites the case of Holland—where an organization for this purpose has been in existence since 1881—to show that such a policy produces improvement in national prosperity

and national physique, besides apparently causing an accelerated rate of natural increase.

We find a German writer, Bluhm (37), who thinks that the German women are inferior, not only to the women of the primitive races but also to other European women,—those of Norway, for example—in their capacity for child-bearing; and she believes there are signs of further deterioration. It is suggested that the trouble is due to the unhygienic manner of life today, and in part to the advance in obstetrics, in so far as the latter favors the hereditary transmission of incapacity for child-bearing.

In Germany, according to Mombert (38), the declining birth-rate since 1876 has been associated with a rise in the proportion of married women. He attributes the whole of the fall in the birth-rate to a decrease in fertility of married women, and argues that it is caused by the increasing welfare of the population and the concomitant growth of prudence and foresight. He supports his contention by showing that the most fertile districts in the great towns of Germany are those with the greatest over-crowded or low-rented tenements; that the towns of highest fertility show the lowest proportion of savings-bank accounts; and that where fertility has fallen most, the proportion of savings-bank accounts has, on the whole, risen most.

Writing upon France, Lucien March (39) says: "The decline of the birth-rate keeps step for step with regard for life and the progress of hygiene, with the improvement of the standard of living and the increase of wealth, with the tendency to live in towns, and the progress of education, with the protection of the weak, and the advance of individualism, especially of the individualism of women. . . . Extinction has always been preceded by some such circumstances as the following: a diminish-

ing marriage-rate and birth-rate, a smaller proportion of male births, sterile marriages, and increased mortality among children." Another French writer, Daugny (40), sees decadence threatening his race because of the disparity between the births and deaths, and advocates immigration into France, pointing out how race fusion has produced a race prolific, energetic, and mentally capable in North Africa.

In 1892 we find that the great French statistician, Levasseur (41), was predicting a more or less hopeless future for his country. He believed there would be no immediate change in the then current tendencies; in fact, he anticipated their accentuation. It is interesting to note here that a large number of the French writers possessed the same pessimistic outlook. For example, M. Jules Simon (42) near the middle of the nineteenth century showed grounds for believing that the French race was degenerating physically and increasing slowly. He noted the fact that the English and German races multiplied faster and spread over the whole earth, while the French did not colonize, did not emigrate, but increased slowly and remained at home. He attributed the deplorable degeneracy to three causes: (a) the conscription of the young and vigorous for the army; (b) the increase of manufactures and other species of urban industry; and (c) the employment of women and children in industrial occupations.

Another Frenchman, Beaulieu (43), feels that from a military and political point of view the decreasing or rather slowly increasing population is undoubtedly a great misfortune, but from an economic point of view the misfortune is not so great. He holds that the situation is regrettable because of its prematurity. He believes firmly that the phenomenon is a concomitant of civiliza-

tion,—meaning material ease, education, equality, and aspiration to rise and succeed in life. In conclusion he points out how ludicrous the attempted remedies (such as taxation of the unmarried, et cetera) are, holding that the cause of the misfortune lies in the new mental condition of the population which is very difficult to change by laws or regulations.

Edward van der Smissen (44) in his book, “*La Population*,” seemed unperturbed. He believed Malthus was wrong and possessed none of his fears; nor did he share in the apprehensions of those who noticed with uneasiness and anxiety the stationary state of the population. On the other hand, we find another of the French writers, Raoul de Félice (45), who concludes that the French character has become weaker, and that enterprise has succumbed to comfort. Still another, Michel (46), holds that the desire of women for rights and their aversion to the “servitude of maternity,” with other causes, are resulting in the decreasing birth-rate; and adds that he prefers an unmarried mother to a sterile wife.

The Sub-Committee on Natality of the Committee on Depopulation in France (47) draws the following conclusion: “The fall of the French birth-rate will not cease and will end in the destruction of the nation, if an attempt is not made, by every rational means, to lessen the opposition which exists between the interests of the individual and the interests of the species.”

It is interesting to note in passing that a few writers, Martin (48) and Sergi (49), for example, attribute France’s position to the frequent wars in which she has been involved, especially the Napoleonic wars.

Professor Willcox (50) of this country thinks that the death-rate in the United States “cannot be expected to fall much below where it now stands in healthy dis-

tricts;" and that "there is no such natural limit to a fall in the birth-rate." He advocates that those persons interested in maintaining the numbers and in improving the quality of the population should gradually educate the public opinion towards a readjustment of the birth-rate in various classes. He feels that such a program would enable society to gain from its best strains—more than it can do under present conditions.

Another American writer, Durand (51), believes that "the danger of undue population growth lies largely in lack of prudence in respect to birth-rate on the part of the poorer and less intelligent classes in the community. The effect of a high birth-rate among such classes in increasing population is less subject to check by a high death-rate in advanced countries than in semi-civilized countries. Our modern feeling of sympathy, and our public and private donations for relieving distress protect the less prudent against the consequences of their multiplication in numbers."

Finally, Dr. Warren S. Thompson (52), writing upon the "Standards of Living as They Affect the Growth of Competing Population Groups," says: "The evidence that this process of the supplanting of people having higher standards by those of lower standards is going on all over the world is conclusive. A higher standard of living has no biological value. It tends to substitute voluntary control of population growth for the processes of natural selection. It seems quite probable, therefore, that if people having high standards of living expect to survive they must be prepared to control the process of competition between themselves and people with lower standards, both by restricting the movements of peoples and by encouraging the spread of knowledge regarding the means of birth control to all classes of the population.

They must learn to use birth control as a method of limitation rather than of elimination as is so often the case at the present time."

In a report of the Royal Commission on the decline of the birth-rate in New South Wales (53), we find an unreserved condemnation of the doctrines advocating the practice of birth control. It is held that Nature in revenge for such practices is bringing about certain bad effects; for example, a "lessening of parental control, the commencement of dissolution in the family bond, and in the dwindling of the size of families,—the dying out of Nature's best school of teaching the lessons of life, and the weakening of the social structure at its base." It is stated also that there is a tendency to undermine the morals of the peoples, "to loosen the bonds of religion, and to obliterate the influence of those higher sentiments and sanctions for conduct with which the development of high national character has ever been associated."

Let us refer once more to the English writers. Have-lock Ellis (54) feels that the decline of the birth-rate is evidence of the growth of a sense of racial responsibility and that it is a lever for raising the level of a race. Welton (55) believed that the spirit and character of a people alone determined their destiny, "and that while one race will multiply its numbers until the lowest form of subsistence fails them, another will increase as rapidly, and constantly keep improving its social condition." Therefore, he says: "Let not any theory sway us which regards men as merely units, and leaves out of view their ambition and their powers; let us rather believe that, with faith in the future, we may go on adding new nations to the Anglo-Saxon race, and continually expanding our resources and our power, while nations which, like France, prefer what is really a stagnant protective system,

as opposed to one of free competition, may preserve but can scarcely increase either their power or their civilization."

Marchant (56) feels that in England, the rapidly declining birth-rate is reducing the increase of population to a dangerously narrow limit; and that the chief factor in the decline is the increasing practice of voluntary limitation of families.

Sir Bernard Mallet (57) writes: "But even if it could be shown, which I much doubt, that if the globe as a whole was within sight of the time when population was beginning to press seriously upon the means of subsistence, I, personally, feel unable to look upon the phenomenon of our falling birth-rate with indifference." Finally from the report of the National Birth-Rate Commission (23), we note the following interesting conclusion: "But in the case of Northern and Western Europe, there is unequivocal evidence that a sharp decline is taking effect [referring to the birth-rate], and we have no warrant for refusing to entertain the belief that, under normal circumstances, the position of France would be ultimately paralleled elsewhere."

From the foregoing the reader can surely retain no doubt that the population question in all its phases is regarded by many of the leading minds as one for serious consideration. There are manifestly different opinions as to the many and various factors operating, but apparently a concensus in regarding it a question of ominous importance. To the reader some of the references included above may have appeared a bit irrelevant and possibly superfluous. Some of them have been included purposely to accuminiate his thoughtful attention. And it is hoped that even with this sketchy background the reader may be better able analytically to appreciate the figures that will now be presented.

CHAPTER III

METHODS AND SCOPE

Unfortunately, vital statistics are not available from all countries. Some of the data that are available are unquestionably poor. But we shall attempt to make use of the poor data, by means of comparison, to show certain characteristics possessed by relatively unreliable figures. The data used in this study were obtained in all cases from *The Statesman's Year-Book*, published by the Macmillan and Company, London. The figures are compiled from the official returns from all countries. In the case of a few countries—England and Wales, Australia, Scotland, Ireland, and Sweden—whose official records were at hand, the *Statesman's Year-Book* figures were checked against the official returns and were found to be the same. Consequently, for the sake of convenience and uniformity, the *Year-Book* figures have been made the sole source of the data used in the present study.

From these vital statistics and by the use of the vital index, the writer proposes to show what populations have the greatest natural increase. A comparison of the magnitudes of the vital indices and their relative rates of increase or decrease over recent years will be made in order to show the relative biological soundness of the different populations herein dealt with. An attempt will be made to determine if there is any correlation between the magnitudes of the birth-death ratios and their rates of increase or decrease; and if significant correlation is found, an inquiry will be made as to just what it means. The effect of the great war and the influenza pandemic on the natural increase of the various populations will be studied.

The variability of the indices of the different countries will be discussed. And finally the last portion of the study will be devoted to a summary of our findings and their direct relation to the population question. It may be stated here that this study does not propose to be exhaustive, but rather intends to give a general picture of the status of the many populations, as shown by their vital indices, where vital statistics are available.

The figures obtained for the births and deaths naturally do not cover the same span of years for all countries considered as some began registration of their vital statistics much earlier than others. For example, Sweden, the first country to record such data, began the practice in 1748; while England and Wales commenced official registration in 1837, Scotland in 1855, and Ireland in 1864. Figures, however, have been compiled for a total of ninety-five countries and states. (No figures have been taken for counties or cities.) The British Empire with its many possessions, and Germany, with independent statistics for its twenty-six states, contribute a large part of the mass of figures. Practically all the European countries have available vital statistics; fewer countries in Asia possess them. The United States, and to a less extent, Canada and the Latin-American countries, are pitifully deficient in vital statistics over any significant length of time. The Australian states present what seem to be very reliable figures, while almost nothing is available from Africa.

The vital indices have been computed after the still-births have been excluded from both the births and deaths. Therefore, all of the figures are comparable on this basis.¹

¹ In the cases of some of the smaller populations, no figures for still-births were given at all, nor was there any indication as to their disposi-

From the raw data were first computed the biometric constants—mean, median, standard deviation, and coefficient of variation of the birth-death ratios—of each geographical unit separately. These constants were derived by the following ordinary statistical formulas, the indices being uniformly grouped in classes of ten units: Arithmetic mean; median (this constant was computed by the simple arithmetic method); standard deviation $\sqrt{\frac{S(Zx^2)}{N}}$; coefficient of variation $\frac{100 \cdot \text{standard deviation}}{\text{mean}}$

in which S denotes summation, Z denotes the frequency, x a deviation from the mean, and N the total frequency.

Owing to the fact, mentioned above, that the indices involved in the biometric constants represent varying time intervals—some extending through the great war years and influenza epidemic of 1918, and others ceasing at the beginning of the war—these figures are not all strictly comparable. Therefore, the mean values of the various geographical units have been computed both including and excluding the years beyond 1913. With such figures one may compare the means under normal and abnormal conditions thereby noting the effect of war and disease upon them.

For the purpose of strict comparison, however, the means are still unsuitable. To permit reliable comparisons to be made, an arbitrary time point has been chosen from which to consider the curves of the indices. Inasmuch as eighty of the countries possessed figures extending back to the year 1888, that year was chosen as a starting point. Two other countries, Spain and

tion. In such cases the still-births have been assumed to have been excluded from the births and deaths. If this assumption should be wrong in any of the data it is felt that the difference would be of negligible significance in this analysis.

Gibraltar, were also included, although their data do not extend back to 1888. Spain has figures from 1864 to 1870 and from 1882 to 1884 inclusive; then there is a gap until 1896 when the figures begin again and continue through to the present time. Gibraltar's figures begin in 1889 and continue through to 1920. Because of the uniform trend of the data of these two countries it was felt that they could be legitimately incorporated. In order to avoid the effect of the war and influenza epidemic, the year 1913 was chosen as the other end of the time span. For studying the behavior of the index curves over this period of time, a straight line has been fitted to each of the series of indices. The lines were fitted by the method of least squares. From these fitted lines it is possible to compare the size or magnitudes of the birth-death ratios at any given year, and the slopes or rates of increase or decrease of the various countries' indices over the years 1885² to 1913 inclusive.

In order to have the different countries on a comparable basis for the purpose of studying the variability of the indices, and in order to eliminate the variability imposed by trend, the standard deviation of the birth-death ratios about their fitted line has been computed for each country. The formula used was the same as given above for the standard deviation, the deviations being taken from the points on the fitted line at yearly intervals. The resultant figures, therefore, give a picture of the amount of variation about the fitted lines, and the several countries may be readily compared as to the variability of their birth-death ratios.

² As a large number of the countries chosen had figures extending back to 1885, this point was chosen as the origin for the fitting of all the straight lines. Thus, in the case of those countries whose figures started in 1888, the value for 1885 is an extrapolated value.

TABLE 1

Showing the biometric constants and their probable errors of all the countries that possessed twelve or more observations

COUNTRY	MEAN	PROBABLE ERROR	MEDIAN	PROBABLE ERROR	STANDARD DEVIATION	PROBABLE ERROR	COEFFICIENT OF VARIATION	PROBABLE ERROR
Hong Kong.....	24.7	± 1.0	24.1	± 1.2	8.9	± 0.7	36.0	± 3.1
Singapore.....	54.4	± 1.8	49.6	± 2.2	14.6	± 1.2	26.8	± 2.4
Penang.....	56.3	± 1.9	52.5	± 2.3	15.4	± 1.3	27.4	± 2.5
Straits Settlements.....	70.3	± 1.5	68.3	± 1.9	13.0	± 1.1	18.5	± 1.6
Dindlings.....	96.0	± 2.9	95.0	± 3.7	24.1	± 2.1	25.2	± 2.3
Malacca.....	101.4	± 2.3	103.8	± 2.9	19.3	± 1.6	19.0	± 1.7
British Guiana.....	102.3	± 3.3	100.0	± 4.2	25.0	± 2.3	24.5	± 2.4
Mauritius.....	102.8	± 2.1	104.5	± 2.6	17.4	± 1.5	17.0	± 1.5
France.....	104.0	± 1.4	107.2	± 1.7	16.6	± 1.0	16.0	± 1.0
Wellesley.....	104.7	± 1.8	106.1	± 2.2	14.5	± 1.2	13.8	± 1.2
British India.....	111.6	± 2.1	114.2	± 2.6	18.4	± 1.5	16.4	± 1.4
Fiji.....	113.5	± 4.8	105.0	± 6.0	41.0	± 3.4	36.2	± 3.4
Chile.....	123.8	± 1.8	125.4	± 2.3	15.9	± 1.3	12.8	± 1.1
Spain.....	127.0	± 1.5	130.4	± 1.9	13.3	± 1.1	10.4	± 0.8
Ceylon.....	127.5	± 2.7	130.0	± 3.4	21.2	± 1.9	16.6	± 1.5
Hungary.....	129.3	± 1.8	134.5	± 2.3	20.0	± 1.3	15.4	± 1.0
Venezuela.....	131.9	± 2.2	134.0	± 2.8	13.1	± 1.6	9.9	± 1.2
Austria.....	133.1	± 1.8	135.9	± 2.2	18.2	± 1.3	13.6	± 1.0
Algeria.....	133.8	± 2.9	131.7	± 3.6	17.8	± 2.0	13.3	± 1.6
Gibraltar.....	135.0	± 2.3	136.0	± 2.9	19.5	± 1.6	14.5	± 1.2
Trinidad.....	135.9	± 1.7	136.2	± 2.2	14.6	± 1.2	10.8	± 0.9
Ireland.....	136.2	± 1.2	134.2	± 1.6	13.9	± 0.9	10.2	± 0.6
Barbados.....	136.5	± 3.3	140.7	± 4.2	28.4	± 2.4	20.8	± 1.8
British Honduras.....	137.7	± 3.1	140.0	± 3.9	25.4	± 2.2	18.5	± 1.7
Greece.....	140.0	± 2.1	140.0	± 2.6	12.2	± 1.5	8.5	± 1.0
Italy.....	140.3	± 1.9	141.8	± 2.4	19.9	± 1.4	14.2	± 1.0
Rumania.....	140.5	± 2.7	145.8	± 3.4	27.4	± 1.9	19.5	± 1.4
Alsace-Lorraine.....	141.2	± 1.4	141.4	± 1.8	12.2	± 1.0	8.6	± 0.7
Switzerland.....	144.2	± 1.4	141.2	± 1.7	14.1	± 1.0	9.8	± 0.7
Sweden.....	144.2	± 1.3	145.6	± 1.6	25.0	± 0.9	17.3	± 0.6
European Russia.....	144.3	± 1.2	145.0	± 1.5	11.8	± 0.8	8.1	± 0.6
Cape of Good Hope.....	145.0	± 3.2	146.0	± 4.1	24.5	± 2.3	16.9	± 1.6
Belgium.....	145.9	± 2.3	150.4	± 2.9	23.0	± 1.6	15.8	± 1.1
Mecklenburg-Strelitz.....	147.0	± 1.4	146.0	± 1.8	11.4	± 1.0	7.7	± 0.7
Bavaria.....	147.0	± 1.6	148.0	± 2.1	14.3	± 1.2	9.7	± 0.8

TABLE 1—Continued

COUNTRY	MEAN	PROBABLE ERROR	MEDIAN	PROBABLE ERROR	STANDARD DEVIATION	PROBABLE ERROR	COEFFICIENT OF VARIATION	PROBABLE ERROR
Japan.....	148.1	± 1.4	149.7	± 1.8	14.4	± 1.0	9.7	± 0.7
Saxony.....	150.5	± 3.6	158.0	± 4.5	33.8	± 2.6	22.5	± 1.8
Portugal.....	150.7	± 2.0	149.6	± 2.5	17.9	± 1.4	11.9	± 0.9
Dutch East Indies.....	151.3	± 3.0	150.0	± 3.8	27.8	± 2.2	18.4	± 1.5
Russian Empire.....	151.4	± 2.6	154.2	± 3.3	13.0	± 1.9	8.6	± 1.2
Württemberg.....	151.8	± 2.4	151.7	± 3.1	22.1	± 1.7	14.6	± 1.2
Mecklenburg-Schwerin....	153.4	± 1.3	152.8	± 1.7	11.1	± 1.0	7.2	± 0.6
Hamburg.....	153.6	± 3.0	159.4	± 3.8	26.5	± 2.1	17.3	± 1.4
Baden.....	156.2	± 1.8	157.5	± 2.2	14.7	± 1.2	9.4	± 0.8
German Empire.....	157.5	± 2.8	158.6	± 3.5	28.5	± 2.0	18.1	± 1.3
Bermudas.....	158.8	± 3.0	157.8	± 3.7	23.8	± 2.1	15.0	± 1.4
Prussia.....	159.6	± 3.6	165.8	± 4.5	33.6	± 2.6	21.0	± 1.7
Bulgaria.....	160.2	± 4.8	167.5	± 6.0	38.0	± 3.4	23.7	± 2.2
Saxe-Altenburg.....	160.7	± 1.8	162.5	± 2.3	14.8	± 1.3	9.2	± 0.8
Saxe-Weimar.....	161.2	± 1.8	164.2	± 2.3	14.5	± 1.3	9.0	± 0.8
England and Wales.....	161.3	± 1.1	162.6	± 1.4	14.9	± 0.8	9.3	± 0.5
Reuss (Younger Branch)..	162.7	± 1.4	163.3	± 1.8	11.4	± 1.0	7.0	± 0.6
Finland.....	163.2	± 2.2	167.7	± 2.8	20.9	± 1.6	12.8	± 1.0
St. Lucia.....	163.4	± 1.8	161.9	± 2.3	15.3	± 1.3	9.3	± 0.8
Scotland.....	163.9	± 1.0	164.0	± 1.3	12.3	± 0.7	7.5	± 0.4
Brunswick.....	164.0	± 1.8	164.2	± 2.3	15.1	± 1.3	9.2	± 0.8
Waldeck.....	165.0	± 1.7	165.6	± 2.1	13.9	± 1.2	8.4	± 0.7
Jamaica.....	165.0	± 2.3	169.2	± 2.9	18.8	± 1.7	11.4	± 1.0
Hesse.....	165.4	± 2.6	172.5	± 3.3	20.4	± 1.8	12.4	± 1.1
Costa Rica.....	166.0	± 3.4	170.0	± 4.2	27.2	± 2.4	16.4	± 1.5
Saxe-Coburg-Gotha.....	166.3	± 1.8	170.8	± 2.2	14.5	± 1.3	8.7	± 0.8
Reuss (Elder Branch)....	168.3	± 1.5	168.0	± 1.9	12.2	± 1.1	7.2	± 0.6
Servia.....	168.0	± 2.2	170.0	± 2.7	17.5	± 1.5	10.4	± 0.9
Bahamas.....	169.5	± 3.2	167.0	± 4.0	25.3	± 2.2	14.9	± 1.3
Lubeck.....	169.8	± 1.9	171.7	± 2.4	15.8	± 1.4	9.3	± 0.8
Bremen.....	170.0	± 2.1	172.8	± 2.6	18.3	± 1.5	10.7	± 0.9
Anhalt.....	170.7	± 1.8	173.0	± 2.3	14.8	± 1.3	8.6	± 0.8
Saxe-Meiningen.....	173.3	± 2.4	175.6	± 3.0	19.0	± 1.7	10.9	± 1.0
Schwarzburg-Sonderhausen	173.7	± 1.8	173.3	± 2.3	14.8	± 1.3	8.5	± 0.7
Newfoundland and Labra- dor.....	176.2	± 3.2	181.7	± 4.0	19.0	± 2.3	10.8	± 1.3
Schwarzburg-Rudolstadt..	176.7	± 2.0	179.0	± 2.5	16.0	± 1.4	9.0	± 0.8
Netherlands.....	179.4	± 2.3	175.0	± 2.9	24.8	± 1.6	13.8	± 0.9

TABLE 1—*Concluded*

COUNTRY	MEAN	PROBABLE ERROR	MEDIAN	PROBABLE ERROR	STANDARD DEVIATION	PROBABLE ERROR	COEFFICIENT OF VARIATION	PROBABLE ERROR
Denmark.....	180.3	±1.6	177.1	±2.1	17.2	±1.2	9.5	±0.6
Oldenburg.....	186.4	±3.5	178.3	±4.4	28.1	±2.5	15.1	±1.4
Norway.....	187.3	±1.4	189.2	±1.7	13.3	±1.0	7.1	±0.5
Schamburg-Lippe.....	187.7	±2.2	192.0	±2.8	17.9	±1.6	9.5	±0.8
Lippe.....	188.9	±3.5	195.6	±4.4	29.9	±2.5	15.8	±1.3
Grenada.....	190.4	±2.2	189.5	±2.8	19.2	±1.6	10.1	±0.8
Guatemala.....	193.1	±7.0	205.0	±8.8	47.6	±5.0	24.6	±2.7
Victoria.....	210.0	±1.9	209.3	±2.4	19.4	±1.4	9.2	±0.6
Argentine Republic...	210.0	±2.4	210.0	±3.0	16.0	±1.7	7.6	±0.8
Island of Samos.....	217.8	±3.4	220.0	±4.3	19.1	±2.4	8.7	±1.1
Uruguay.....	230.1	±2.4	230.6	±3.0	22.3	±1.7	9.7	±0.7
Western Australia.....	237.1	±5.0	246.7	±6.3	46.2	±3.6	19.5	±1.6
Australia.....	239.2	±2.1	243.3	±2.7	19.4	±1.5	8.1	±0.6
South Australia.....	251.8	±2.5	253.3	±3.1	23.4	±1.8	9.3	±0.7
Queensland.....	253.9	±4.2	257.8	±5.3	42.7	±3.0	16.8	±1.2
Tasmania.....	255.2	±3.1	258.3	±3.9	29.0	±2.2	11.4	±0.9
New South Wales.....	255.6	±2.6	260.9	±3.3	26.6	±1.9	10.4	±0.7
New Zealand.....	286.9	±3.8	282.0	±4.7	38.6	±2.6	13.4	±0.9
Falkland Islands.....	308.8	±18.4	265.0	±23.0	124.7	±13.0	40.4	±4.8

In Table 1, there is a list of the different countries with their biometric constants, as mentioned above, and their probable errors.

The purpose of the statistical method of treatment, as just outlined, has been obviously to arrange the material for study. The next step, therefore, is to group the various geographical units according to the statistical values they may possess. By so doing it is hoped that a clearer impression may be obtained as to the comparative biological status of the different populations considered.

The first grouping is made on the basis of the mean values of the birth-death ratios. This will be discussed in the next chapter. Realizing that the time interval is so

variable, in so far as some of the mean values involve observations extending back to the middle of the nineteenth century and others only to the end of that century, the groups have been made comparatively large. In this arrangement, it is felt, the groups present a true picture of the relative mean values of the various geographical units. The Dutch West Indies, Mexico, United States, and Canada have been included but need a word of explanation. The vital statistics for the former place began in 1911 and are available through 1920. These ten observations have only been averaged and presented as a suggestion of the status of this unit. The figures for Mexico are obviously poor and cover only the period from 1893 to 1903 inclusive. Regarding them The Statesman's Year-Book (58) remarks: "The systematic registration of births and deaths is defective, especially outside the Federal District." The figures have been averaged and tabulated purely to give a rough suggestion of what Mexico's status may be. Likewise, in order to have some comparative impression of the United States and Canada, figures of the Birth Registration Area, for the former, for the years 1915 to 1922 inclusive, have been used. For the latter country, (Canada) statistics for four of the Canadian provinces for the years 1911 to 1921 inclusive have been averaged. Table 2, Chapter IV, shows the arrangement of the means of the countries and states, grouped in units of thirty, including the war and influenzal years. In the footnote of Table 2 may be noted those countries whose grouping would change should the war and influenzal years be excluded. This comparison will be made clearer in a subsequent chapter.

In order to study the relative biological soundness of the various populations, the magnitude and slope values are the next to be grouped. These values have been tabled

one against the other the better to show their relation. The slope values, it is remembered, are the amounts which the vital indices increase or decrease each year; the magnitudes are the values of the birth-death ratios at the year 1885. The figures in Table 3, Chapter V, are all based on the time period from 1885 to 1913 inclusive, and are, therefore, strictly comparable.

The effect of the war and influenza pandemic can be shown in two ways. In Table 7, Chapter VI, are listed the mean values, the first column including the years beginning 1914 and including in most instances the year 1920 (and in a few instances the year 1921, as noted); and in the second column are the mean values excluding the years after 1913. Table 9, Chapter VI, presents those countries whose birth-death ratio trends were fitted with straight lines and which possess data beyond 1918. For each country are tabled the predicted and actually observed birth-death ratios for the years 1918, 1919, 1920, and 1921. The predictions, obviously, are obtained from the fitted lines which include figures from 1885 to 1913, and therefore indicate the vital indices that might have been expected had normal conditions continued to exist through the years 1914 to 1918 inclusive. There are also supplementary tables which will be explained when the effect of the war and influenza on the birth-death ratios is discussed.

For the purpose of comparing the variability of each population's vital indices, the standard deviations which were computed from the trends offer the best means. These values, as indicated above, measure the variability of the birth-death ratios apart from the secular trend in time. In other words, the variability due to the change in magnitude as a result of the twenty-nine year interval is eliminated, and only the pure variation of the index

values themselves is expressed. In Table 13, Chapter VII, are grouped the various geographical units according to the degree of variation their vital indices possess. The reader is reminded again that these values are computed over the same interval of time and are subject therefore to comparative study.

We are now ready to take up separately the different groups and note the relative status of the different populations involved, as measured by their vital indices.

CHAPTER IV

MEAN VALUES OF VITAL INDICES

The first grouping to be studied is that of the mean values of the vital indices. Examination of Table 2, and the accompanying world map of the mean birth-death ratio values (Fig. 1), suggests several interesting things. The outstanding feature is perhaps the tendency of the values to increase as their distance from the equatorial belt becomes greater. The units lying in closest proximity to the equator are: The Straits Settlements with a mean value of 65.4 (70.3);¹ the Dutch East Indies with a value of 145.6 (151.3) (these figures involving only Java, Madura and the Outposts); the Dutch West Indies whose mean is 122.2 (143.1); Venezuela, 135.0 (131.9); and British Guiana with a mean birth-death ratio of 102.8 (102.3). The Straits Settlements—Singapore, Dindlings, Wellesley, Penang, and Malacca—whose vital statistics have shown remarkable uniformity, are, if the figures be reliable, evidently in an unsound biological condition. Immigration is fairly large to the Settlements, mostly from China and India in the order named. The Dutch East and West Indies appear to be biologically more prosperous. The former's mean index value, however, is based only on Europeans and persons assimilated to them; and "the whole population is legally divided into Europeans and persons assimilated with them, and natives and persons assimilated with these" (58). It is questionable, therefore, whether a picture of the entire population would

¹ Throughout this discussion the means excluding the war and influenza years will be given first and the means including these years will be parenthetically placed immediately afterward.

TABLE 2

Showing the means of the various countries arranged in groups of thirty units

Means 10-39	
Hong Kong	Greece
	Sweden
Means 40-69	Rumania
Singapore	European Russia
Penang	Bermudas
	German Empire ²
Means 70-99	Baden
Straits Settlement ¹	Mecklenburg-Schwerin
Mexico ⁴	Hamburg
Dindlings ²	Württemberg
	Saxony ²
Means 100-129	Prussia ²
Mauritius	Dutch East Indies
British Guiana	Portugal
France	Russian Empire
Malacca	Venezuela
Wellesley	Algeria
British India	Austria
Fiji	Gibraltar
Chile	British Honduras
Hungary ²	Barbados
Ceylon	Trinidad
Spain	Ireland
	Italy
Means 130-159	
Dutch West Indies ^{1,4}	Means 160-189
Switzerland	Bulgaria
Belgium	Costa Rica
Japan	England and Wales
Cape of Good Hope	Bahamas
Bavaria ³	Jamaica
Mecklenburg-Strelitz	St. Lucia
Alsace-Lorraine	Scotland

¹ Excluding the years beyond 1914, these countries would recede to the next lower group.

² Excluding the years beyond 1914, these countries would advance to the next higher group.

³ Including 1914 only.

⁴ Averages.

TABLE 2—*Continued*

Hesse	Means 190-219
Brunswick	Guatemala
Saxe-Weimar	Grenada
Waldeck	Canada ⁴
Saxe-Altenburg	Argentine Republic
Saxe-Coburg-Gotha	Island of Samos
Reuss (Elder Branch)	Victoria
Reuss (Younger Branch)	Means 220-249
Finland	Western Australia
Servia	Uruguay
Lubeck	Australia
United States ⁴	Means 250-279
Newfoundland and Labrador	Tasmania ¹
Anhalt	Queensland
Saxe-Meiningen	South Australia
Schwarzburg-Sonderhausen	New South Wales
Schwarzburg-Rudolstadt	Means 280-309
Bremen	New Zealand
Netherlands	Falkland Islands ²
Oldenburg	
Lippe ²	
Schamburg-Lippe	
Norway	
Denmark	

appear as flattering as the above figure indicates. The Europeans are probably living under more favorable conditions than the natives. As for the Dutch West Indies, the figures are likewise exclusive of the negroes and Indians living in the forests. The number of observations in this case being so few, it is probably safer to accept these figures as only suggestive. British Guiana and Venezuela also present comparatively low index values, and are in general in keeping with the tendency suggested above.

We observe that, with a few exceptions, countries lying beyond the equatorial belt show higher mean values. Hong Kong presents the saddest picture of all places



considered. The population of Hong Kong has increased from 221,441 in 1891 to 625,166 in 1921. About 98 per cent are Chinese. Immigration is very great, coming mostly from China and composed largely of males. The basis for the last statement is that quite half of the Chinese people in Hong Kong are males (1913). The very low index figure is from an inordinately low number of births and a high number of deaths. There are certain new territories with a population of 90,594 in 1911, and 100,800 in 1920, that do not come under the jurisdiction of the British Sanitary Authorities. It is indeed possible that there are some deaths among this population that occur and are registered in Hong Kong, while their births are not so recorded. Also, it is only reasonable to assume that the transient population in Hong Kong associated with the constant flow of emigration from China may well contribute to the large number of deaths and low number of births.

British India with its mean value of 112.5 (111.6) is in accordance also with the general tendency, as is also Algeria, with a slightly higher mean value. Going on northward in Europe (including with this European group also Japan) none of the countries tabled, with the exception of Hungary, France and Spain, shows a mean index of less than 135. France's natural increase has for many years been nearly at a standstill, and presents a mean birth-death ratio of 107.7 (104.0). Although the economic condition of France cannot be said to be poor, there is probably a certain customary standard of living that would automatically and necessarily become lower, other things remaining equal, if the birth-death ratios should be increased. The effect of this restraining influence on France's tenacious retention of her picture of close biological balance is probably great. There have been

various and sundry explanations of France's peculiar position as shown by many of the opinions already cited. There can be no doubt that there is an indefinite number of factors contributing to produce France's present condition. The French Commission on Depopulation (59) includes many factors in its analysis. They may be summarized as follows: Abortion, which is said to be on the increase; abnormally high infant mortality (one-third of the total deaths is said to be under one year); a higher death-rate between ten and fourteen years of age than is found in Prussia, England or Sweden, tuberculosis accounting for one-third and pneumonia for one-fourth of the deaths between these ages; the increase of direct taxation 50.7 per cent, and indirect taxation 128.2 per cent since 1869, "though even this may be more than balanced by the increase in national wealth." Also, certain civil legislations are believed to be contributory to the low birth-rate; for example, "the necessity of parental consent by legal certificate and the advanced age (21 for women, 25 for men) before which marriage cannot take place with this consent, which hinder marriage so much that the parties are often tempted to dispense with the ceremony altogether." (Some of these laws have been amended.) Urbanization is not considered to have had a very decisive effect on the birth-rate. The increased activity of women in various industries, which the Commissioners believe to be a result of a desire to better themselves and their children, is considered as a contributory cause of the low birth-rate. Industrialization is thought to be contributory by increasing the death-rate more than the birth-rate. Finally, "the fact that Roman Catholicism forbids the restriction of families, except by continence, and the decline of religious sentiment in France, have often been considered determining factors in

the reduction of the birth-rate." This point, however, is questioned, and Mr. Coghlan says, "speaking generally, 'the effect of religion as a deterrant to the practice of prevention is not particularly obvious.'"

Lucien March (39) puts much stress upon the legal constraint which makes the responsibility of fatherhood particularly heavy. He writes: "The laws regulating labor and the laws of compulsory education have taken away from the father the power of turning the work of his child to profit before it has reached a certain age, and the laws connected with old age pensions have made it unnecessary that people should take the precaution of having children in order to insure their being provided for in their old age." Summarizing, he says: "Thus the limitation of births may be seen to have become generalized to an alarming extent, and to have grown indeed in proportion as the burden of the surviving children of each family becomes more heavy. It has taken place either, as in the case of the minority, by a restriction that is entirely voluntary; or, as in the case of the majority, as an effect of either social or legal constraint."

Thus it becomes evident that there is a multiplicity of factors that must be taken into consideration in order to explain France's position. We see, however, in very recent years a tendency to reestablish herself. In 1920 and 1921 her birth-death ratios were greater than in any year since 1877. Whether or not this rise in natural increase is merely a compensatory one it is difficult to say; and whether or not she will reassume her stationary tendencies is problematical.

Looking again at the values of the various countries, we see that Spain occupies a slightly better position in the scale of biological soundness with a mean of 127.2 (126.5). Austria and Hungary present comparatively better con-

ditions with mean index values of 135.9 (133.1) and 131.4 (129.3) respectively.

Proceeding still farther northward, the tendency toward increasing mean values is still more marked. Excepting Sweden and Ireland, no one of the countries has a mean vital index of less than 145. Norway has the highest mean index of 188.5 (187.3), while Denmark and the Netherlands have the values 178.4 (179.6) and 176.1 (179.4) respectively. Germany, England and Wales, Scotland, and Finland all possess means of 160.0 or more. The Russian Empire has a mean vital index of 151.4. The number of observations here, however, are relatively few and this figure should be taken only as a suggestion. European Russia possesses a mean index of 144.3 which is probably more accurate and which fits nicely into the general scale of values.

Sweden, with a mean of 144.0 (144.2), which is materially lower than those of her immediate neighbors, has always been known as a very stable country, relative to her population. Perhaps the reason for her comparative deficiency in this comparison is due to the fact that the mean vital index has been computed on 172 years of vital statistics. Inasmuch as her increase has been uniformly slow since 1749, when she began with a vital index of 102.3, these earlier and lower values have no doubt had a diminishing effect on her total mean value. This can be shown to be true, for when the birth-death ratios are averaged from, say 1873 to 1920 inclusive, we get the value of 167.0. Excluding the years beyond 1913 we get the value of 169.3, which places Sweden in the same class with the neighboring countries.

Ireland on the other hand, whose mean vital index is 137.3 (136.2), has been subjected to definite and evident troubles. This population demonstrates uniquely the

effect of emigration on what may be said to be a healthy race from the standpoint of reproduction. According to official census returns, Ireland's population has decreased from 6,552,385 in 1851 to 4,390,219 in 1911. (There was no census taken for the year 1921.) Per square mile, the population has decreased from 201 in 1851 to 135 in 1911. The total number of Irish who emigrated from Ireland from 1851 to the end of 1920 was 4,338,199. Despite this exorbitant emigration, Ireland has maintained a mean birth-death ratio of 137.3 (136.2), and is increasing at the rate of 0.44 each year. It is only reasonable to assume that of the Irish who emigrated, the majority was in the reproductive ages. The effect of such an exodus is apparent.

It is interesting to note here that Newsholme and Stevenson (18) showed by their corrected birth-rates that the fertility of the Irish population has actually been increasing; and that Ireland is the only country among those they studied that gives such a picture. Austria is shown to be the only country with a stationary birth-rate. It is further shown that Denmark's fertility has decreased more than Sweden's, and still more than that of Norway. According to the writers, England's decrease has been greater than Scotland's. Belgium and Saxony also show a comparatively great decline in fertility. These results will be referred to subsequently in more detail.

To the south of the equatorial belt, in the eastern hemisphere, is found a similar change to that found to the north. The figures for the Fiji Islands and the Island of Mauritius, 100.7 (113.5) and 102.7 (102.8), respectively, are slightly higher than those for the Straits Settlements, although they are scarcely above the self-maintenance level of 100. The population of the former unit in 1920 was composed of Fijians and Indians, the first comprising a

bit over half. Mauritius is largely made up of Indians with a few Chinese.

Next in order is the Commonwealth of Australia which possesses a mean vital index of 237.0 (239.2). The states of this Commonwealth and New Zealand offer a most interesting contrast to the places mentioned in the preceding paragraph. Victoria has the lowest mean index value of 210.3 (210.0), while the Dominion of New Zealand possesses the mean of 291.6 (286.9). In general it may be said that these states are affected by just the opposite migratory influence as that suggested above for Ireland. The combined population of the former was in 1861, 1,168,149, and in 1918, 5,030,479. In 1921 it was 5,436,794. Of this nearly four million increase (referring to the 1918 figure), 20 per cent was due to net immigration (surplus of immigration over emigration), and 80 per cent to natural increase or excess of births over deaths. The obvious reason, fundamentally, for this phenomenal growth is that Australia is a relatively new country, having been "officially" opened up by the British in 1788.

The factors affecting the growth of Australia have been summed up by Knibbs, Commonwealth Statistician (60), as follows: (1) Mineral discoveries; (2) pastoral development; (3) agricultural expansion; (4) progress of manufacturing industries; and (5) assisted immigration. The majority of the immigrants were in the prime of life. The birth-rate in the earlier years was high. This tended to give Australia a population of young virile people, which condition presupposes a comparatively low death-rate. Furthermore, the immigrant races consisted chiefly of the natives of the three British Divisions and their descendants. According to the authority just mentioned, at the Census of 1911, "out of a total population of 4,424,535 persons whose birthplaces were specified, no fewer than

3,667,670, or 82.90 per cent, were Australian born; while the remainder, 590,722, or 13.35 per cent, were natives of the United Kingdom, and 31,868, or 0.72 per cent, were natives of New Zealand; that is, 96.97 per cent of the total population at the date of the Census had been born in either Australasia or the United Kingdom." Of the remaining 3.03 per cent, 2.21 per cent were of European or American birth, and 0.82 per cent Asiatic. Thus it is evident that the immigrants were of biologically healthy races, which inferentially may be considered as one of the factors also responsible for the high mean values of the Australian states. And though as yet there may not be what may be called an Australian type, the product is high indeed in the scale of biological vigor and soundness.

Referring again to the results of Newsholme and Stevenson (18), we find that they showed that the greatest decline in fertility of all the populations considered is manifested by New South Wales, Victoria (Belgium and Saxony), and New Zealand in the order named.

The South African unit, Cape of Good Hope, is in keeping with the general tendency of increasing birth-death ratios with a mean of 150.8 (145.0). The population in 1911 was about two-thirds colored. The vital statistics are apparently only partially registered which permits this figure to be taken only as suggestive.

In the South American continent, those places not yet considered are Uruguay, Argentine Republic, Chile, and the Falkland Islands. With the exception of Chile they possess high index values. In the latter country (Chile) the indigenous inhabitants are of three branches: the Fuegians, who are mostly nomadic; the Araucans, who live in the valleys or on the western slopes of the Andes; and the Changos, who inhabit the north coast region and are employed as laborers. The majority of the popula-

tion, however, is of European origin,—largely Spanish, French, Italian, German, and British in the order named. Immigration is small and is encouraged by the Government. The Falkland Islands possess a mean index of 310.3 (308.8). There is a great preponderance of males on the Islands. The total inhabitants (estimated in 1919), including South Georgia (population, 1000 with only three females) was 3255 (2271 males and 984 females). The death-rates, according to returned figures, are very low, being in 1919, 8.2 per 1000. A death-rate of 4 per 1000 was recorded in 1918. The birth-rates range from 13.4 to 36.0 per 1000. The mean index value was computed on a total of twenty-one observations. It is felt that the reliability of these figures is questionable.

Going northward again, we have the British West Indies, composed of the Bahamas, Barbados, Jamaica, Trinidad, and the Windward Islands (St. Lucia and Grenada); the Crown Colony of British Honduras; and the Republic of Costa Rica,—all of whose index values vary considerably, but on the whole are comparatively high. Guatemala has a mean index that is comparatively very high, 193.1. Her returns are irregular and the system of registration imperfect, the number of deaths recorded being said (The Statesman's Year-Book) to be considerably below the actual number. Mexico, whose value is based on eleven observations, also is known to have imperfect registration of births and deaths. Assuming the other means to be approximately correct, they are slightly higher than would be expected in the light of what has been said above. Probably one reason is that the figures refer largely to the European element of the population, while vital statistical information pertaining to the native element is not so easily accessible. More will be said bearing upon this point in the succeeding sections.

Farther north, in the North American continent are the geographical units, United States, Canada, Newfoundland and Labrador, and the British Bermudas, whose mean indices are of the same order as the northern European countries. The figure for the United States, 173.5, is the average of the birth-death ratios for the years 1915 and 1916. For the eight years, 1915 to 1922, the average is 176.1. (These figures are based on returns from the Birth Registration Area.) The figure for Canada, 200.7, is based on the ratios for the years 1911 to 1913 inclusive. Including the years 1914 to 1921, the average vital index becomes 200.4. It will be remembered that these figures for Canada are based on four provinces,—Alberta, Nova Scotia, Ontario, and Quebec. The data from both countries are probably accurate and their positions in the scale of indices may certainly be taken as a true indication of their relative status. What has been said of the migratory influences affecting Australia may in general be applied to the Canadian provinces and the United States, but to a less degree. Newfoundland and Labrador have a mean value, based on sixteen observations of 175.8 (176.2). The British Bermudas farther south, one of the colonies of the West Indies, has a mean birth-death ratio of 155.9 (158.8).

From the above analysis of the groups of geographical units, as tabulated in Table 2 and graphically shown on the world map accompanying, the association of mean vital index values with geographical position seems reasonably apparent. There appears to be a banding effect, in other words, in certain latitudes. Whatever the explanation may be, racial or environmental, doubtless both, from this review I think it may be fairly concluded that the Canadians, Northern European peoples (with whom the Australians may be included), and the North Americans are comparatively the soundest biologically.

This fact has a practical relation to the United States selective immigration ruling which favors the Northern European races. There are two aspects to the legislation. If we are desirous of populating the United States with people who in turn are potentially capable of reproducing so effectively as to predominate in our own population; or in other words, if it is felt that we need our population increased for the sake of having a maximum number, whether the increase be from good or bad foreign stock, then the selective feature of the ruling is admirable. On the other hand, if our population as it is, is capable of decent self-maintenance and growth (as it unquestionably is); and if over-population of the States is ultimately inevitable, which is inferentially certain, then the selective feature of the ruling discriminates in favor of the wrong races. Instead of the northern Europeans, the southern races should be encouraged to emigrate, thus supplying the so-called need for the working class, and possibly avoiding premature over-population. This argument is based on the assumption that the same rates of reproduction would obtain in this country as in the immigrants' native lands. This assumption is not, however, entirely true. According to Hill (61): "White women of native parentage are much less prolific than those of foreign parentage." The second generation, however, "of foreign origin is less prolific than the first generation, although more prolific than the whites of native parentage." According to Eastman (62): "There is no question but that the foreign element in the population of New York State affects the general birth-rate in this State to an extraordinary degree." He points out "that 73.1 per cent of all births to foreign born women were to Italian, Russian and Austro-Hungarian mothers and that these races accounted for nearly 27 per cent of all births occurring in the State

outside of New York City, although they furnished less than 7 per cent of the total population." Pearl (7) finds that "immigrant stocks are in the stark, raw business of reproduction vastly superior to native stocks, even to native stocks which have been here only a generation or two. Beyond this point there is no definite evidence, but all that can be inferred . . . seems to indicate that it is a general rule that the farther we get in the fusion process from pure fresh immigrant stock the lower the vital index becomes."

Thus the evidence seems to be that the birth-death ratios of immigrant races soon approximate those of the population where they settle. That this tendency is not necessarily universal is indicated by the fact, mentioned earlier in this study, that, in the Argentine, the Italian immigrants have apparently become more prolific than the natives. Furthermore, certain of the less prolific races become more prolific among new populations, as, for example, the French in Canada and the British in Australia. These observations do not, however, contradict the view that immigrants tend to approach in fertility the index of the native populations with whom they take up their abode. They indicate rather that there are other factors that must be taken into consideration. It appears that the most important factor is the stage of development of the country into which aliens are coming. By this is meant that the rapidity with which an immigrant element will rise or fall to the native fertility standard is dependent to a large extent upon the stage of development (economic and social) reached by the native peoples. Undoubtedly Argentina's stage of development, plus other factors such as favorable environment and the like, is more conducive to a high natural increase among a foreign element than is the case in the United States or England. But the time

is approaching, perhaps quickly, when Australia, the Argentine, Canada and other comparatively virgin areas will have reached a stage of development that is no longer conducive to marked racial differential fertility within their borders. They will then possess one, more or less common, index of fertility to which newer additions will quickly approximate, as is the case in the United States and other countries. In other words if the Italian immigrants referred to as more prolific in Argentina than the natives were transplanted to the United States, it is probable that their vital index would gradually diminish in the process of assimilation, just as that of the Italians now here has done. On the other hand, if the Italian immigrants to the United States chanced to go to Argentina instead, they would probably show the same fertility there as do their fellow countrymen. Thus differential racial fertility within a give counntry is evidently a relative phenomenon, depending upon more than one factor; and both observations regarding the natural increase reactions of immigrant races are correct.

It will be noted that Pearl said (see above) "that the farther we get in the fusion process from pure fresh immigrant stock the lower the vital index becomes." Now it is conceivable that if an alien race becomes sufficiently strong in numbers in a given place fusion may be retarded or may even fail completely to take place. This condition is already a fact in many of our larger cities to-day where Poles, Italians or other nationalities become segregated, as it were, and increase among themselves with no meagre rapidity. What would be the result if fusion should become less? It seems to the writer that it must diminish sooner or later if foreign stock is continually admitted to this country. As it is now, each new quota of immigrants for at least the first two generations reproduces faster

than our own native stock. Is this a desirable situation or not? If not, what are the people of the United States doing about it?

First, let us see what the mortality of our immigrants shows. A study by Dublin and Baker (63), in 1920, which confirms a previous similar study by the same writers, shows that "the unfavorable conditions of life and work among foreign races to which attention was directed in the study for New York are found to prevail in Pennsylvania. . . . The much more favorable economic conditions under which they live in the United States than in their own countries should result in lower death rates. But in several instances, we found that this does not prevail; the facts indicate on the whole deterioration rather than improvement." At this point the writers pertinently ask: "Is it possible that our immigrants are not representative of the best in their native countries?"

Eastman (64) in a study upon the relation of parental nativity to infant mortality showed that "the infant mortality from communicable diseases was almost 75 per cent greater among children of foreign mothers than among the babies of native mothers; from respiratory diseases it was over 100 per cent greater, and from gastro-intestinal diseases the excess was about 78 per cent; but the rate from prenatal and other causes peculiar to early childhood was higher among the native element by over 20 per cent." Commenting upon these results, Pearl (7) says: "The few deaths from prematurity and congenital defects among the Italian and Slavic mothers indicate that superiority of innate biological constitution which is generally associated with emigrating stocks. On the other hand, the high death-rates among these infants from causes which Eastman classes as communicable, respiratory, and gastro-intestinal is chiefly due to the mothers' ignorance."

Guilfoy's (65) study of the death-rates of New York City as affected by its cosmopolitan population is corroborative of Eastman's findings.

Pearl (7) found that the foreign population in respect to the vital index is superior to the native population; that the native population index is higher in rural than urban communities; and that the foreign element shows a higher index in urban than in rural areas. This, however, he points out to be explicable on the basis of a more favorable age constitution in urban than in rural foreign populations.

It is extremely unfortunate that our statistics in this direction are as yet too crude to permit a really penetrating study of all the factors involved. Certain facts, nevertheless, are patent. Our country is open—true, in a numerically restricted fashion—to foreign stocks. In our environment (used in the broadest sense), the foreign element is more prolific, at least for the first few generations, than our own stock, and equally prolific in subsequent generations. This seems to be true in general of any race whether it be southern or northern European. Without any regard for the quality of our foreign element, certain of our American institutions are doing everything possible to better the hygienic environment of this element; and they are working arduously, but sadly without discrimination, to make this element's life more comfortable in every way, all of which adds to the attractiveness of this country to other foreign stocks yet to emigrate. For these noble efforts the self-respecting American citizen is paying; paying to insure the continued existence of our foreigners and thus encouraging them to multiply as rapidly as we do, whether they be fit or unfit.

Scanning the literature on this question one finds as usual a variety of opinion. In comparatively recent years

some of our writers are beginning to attack the question with seriousness. Professor Robert de C. Ward (66) writes concerning the eugenic aspects of immigration: "The need is, indeed, imperative for applying eugenic principles in much of our legislation. But the greatest and most logical, the most effective step that we can take is to begin with the proper eugenic selection of the incoming alien millions. We should see to it that we are protected, not merely from the burden of supporting alien defectives, but from that 'watering of the Nation's life blood' which results from their reproducing their kind after admission." He then quotes Professor Pearson: "'You cannot change the leopard's spots and you cannot change bad stock to good. You may dilute it, possibly spread it over a wide area, spoiling good stock, but until it ceases to multiply it will not cease to be.'" Professor Ward then concludes with the following cogent remarks: "The conservation of our national resources. How much we hear about that in the United States. Conservation of American forests is important. So is conservation of American coal, and of American oil, and of American natural gas, and of American water supplies, and of American fisheries. But the conservation and improvement of the American race is vastly more important than all other conservation. The real wealth of a nation is quality of its people. Of what value are endless acres of forest, millions of tons of coal, and billions of gallons of water, if our race is not virile, and sane, and sound?"

Considered in the light of the question asked by Dublin and Baker (63), this conclusion is thought-provoking.

Durand (51) discusses immigration mostly from the quantitative aspect. "In our own country the natural growth of population is greatly augmented by immigration. Had there been no immigration from 1900 to 1910

our population would have increased about 14 per cent. As it was, it increased 21 per cent. Immigration accounted for one-third of the addition to our numbers. Moreover, of the natural increase in the population, a disproportionate share was attributable to the presence of the foreign born, of earlier immigration. With their lower standards of living they may have larger families than the older native stocks.

“If the admission of multitudes of foreigners to our shores served to relieve the pressure of population in the countries whence they came, we might at least congratulate ourselves upon a philanthropic action in opening wide our doors. As a matter of fact, it seems likely that the possibility of sending surplus populations elsewhere tends to stimulate the birth-rate in those countries. The policy of the United States and of various other nations in failing to restrict immigration, or even encouraging it, probably increases the rate of population growth in the world as a whole. However that may be, it is hard to be patient with those who believe that further large immigration will be beneficial to our own country.” Then in conclusion he says: “We no longer have a great overplus of unused resources clamoring for development. It is principally into the manufacturing industries that present day immigrants are entering. Hardly an eighth of the foreign born added to our population during the last decade went upon the land; the great bulk of them crowded into our cities. The flood of immigration is simply hastening the time when we shall become dependent on the outside world for the very means of subsistence, when our standard of living will fall, when we shall be forced into militarism, when the masses of our people will be virtually the serfs of the few owners of natural resources.”

These latter remarks are also thought-provoking when Pearl's findings regarding the vitality of the urban foreign born are recalled.

Is it not obvious then, that the immigration problem in this country is one that needs to be handled, not blindly, but with serious thought? It is the writer's opinion that man's efforts affect but little the steady secular trend of evolution. Our ideas and convictions are only evanescent. What today is right may be wrong tomorrow, and what today savors of wisdom may tomorrow appear ridiculous. But be this as it may, if man's heritage includes his country, his progeny, and his posterity; and if immigration as it now exists is a factor not capable of adding to the future welfare of our peoples; and if what we *can* do might cause only a little benefit in the years to come—should we not do what our observations now suggest would be wise?

It is earnestly hoped that the above brief discussion will at least suggest some of the many variables that must be considered seriously if we are not to allow ourselves to drift into a situation where taking thought will no longer avail.

CHAPTER V

TRENDS OF VITAL INDICES

In the preceding chapter we noted the relative status of the various countries as indicated by their mean vital indices. Let us now examine these populations from the standpoint of their rates of natural increase. It will be remembered that in order to allow accurate comparisons of the different populations to be made on this basis, only those countries whose vital statistics extend back as far as the year 1885¹ are to be herein dealt with. The reader will also recall that straight lines were mathematically fitted to the trends of the birth-death ratios of these countries. The slope values of these lines represent the rates of increase or decrease of the birth-death ratios for each year. The term magnitude that will be used freely in the following discussion refers to the size of the vital index at the year 1885.

Referring now to Table 3, in which are tabulated in correlation form the magnitudes of the vital indices of the various countries (those having sufficient data) at the year 1885, and the slopes, or trends of increase or decrease, and comparing both values, one notices first, in general, a confirmation of the observation discussed above with reference to the mean, that magnitude and slope values of the birth-death ratios are associated with geographical position. Equally outstanding is the association between magnitude and slope of the different units. It will be noted that in general those places with high magnitudes have low rates of increase, while those with low magnitudes have high rates of increase. There are some exceptions to

¹See footnote, page 50.

TABLE 3
Showing the magnitudes (at the year 1885) and the rates of increase or decrease of the vital indices arranged in correlational form

MAGNITUDES	SLOPES					TOTAL
	-1 to -1.9	-0 to -0.99	+0 to +0.99	+1 to +1.99	+2 to +2.99	+3 to +3.99
Under 50		Hong Kong	Penang, Singapore			
50-99		Straits Settlements	Wellesley, British Guiana	Fiji	British Honduras	3
	Dindlings	France, Mauritius, Malacca	Chile, Dutch East Indies, Italy, European Russia, British India, Portugal, Ireland, Hungary, Austria, Rumania, Belgium, Hamburg	Alsace-Lorraine, Saxeburg, Altenberg, Russian Empire, German Empire, Saxe-Weimar, Switzerland, Württemberg, Spain, Bavaria, Gibraltar, Bulgaria, Bermudas, Saxony, Trinidad, Baden, Japan	Hesse	5
100-149						33
150-199	Bahamas	Barbados, Mecklenburg Strelitz, Brunswick, Jamaica, Reuss (Elder), Anhalt, Grenada	Schwarzburg-Sonderhausen, Schwarzburg-Rudolstadt, Mecklenburg-Schwerin, Saxe-Coburg-Gotha, St. Schamburg-Lippe, St. Lucia, England and Wales, Scotland, Reuss (Younger), Costa Rica	Prussia, Saxe-Meiningen, Denmark, Lippe	Netherlands, Oldenburg	32
200-249		Guatemala	Victoria, New South Wales, Australia	Uruguay, Queensland	Tasmania	7
250-299		South Australia, New Zealand				2
Total . . .	2	15	36	23	5	1
						82

this association in the table, both real and apparent, which will be discussed subsequently.

Assuming a high degree of association between the two values as just suggested, what would it mean? Fundamentally, it would mean that under a "normal" set of conditions remaining relatively the same, there is something that tends to limit the extent to which a population may reproduce and maintain an increasing birth-death ratio. This does not mean that a country may not change its program of living, such as shifting from an agricultural to an industrial, and recommence an increasing vital index. Nor does it mean that a population may not change its general standard of living and in consequence its birth-death ratio.

It is felt that the change from an increasing slope to a decreasing one is a continuous phenomenon and not one of discontinuity. That France, for example, at one time in her history showed a relatively high positive slope value is surely true. And it is reasonable to assume that her slowly decreasing trend is not the result of some particular catastrophe which immediately, figuratively speaking, started her population under-reproducing, but that such a reversal was a slowly evolving and continuous phenomenon. Furthermore, there are seen slope values grading one into another; for example, Sweden, with a positive value of 0.076, and some of the German states with slightly higher slope values; France with a negative value of 0.006, and other German states with slightly greater negative slopes, and so on.

But the interesting point about Table 3 is that the two variables, magnitude and slope, while apparently closely related, fail to give a significant correlation coefficient,²

² This coefficient is a figure derived by the formula, $r = \frac{S(xy)}{N\sigma_x \cdot \sigma_y}$ in which S denotes summation; x and y are deviations from the means of

measured by its probable error.³ In evaluating the significance of correlation coefficients, one which is three times or more its probable error is considered probably significant. The coefficient computed on the figures as tabled is -0.086 ,⁴ with a probable error of ± 0.074 . This is obviously insignificant. Theoretically, in this heterogeneous group of countries and states, if there actually exists a relation between magnitude and slope, as contended above, the correlation should prove significant. Consequently, there is somewhere an inconsistency whose source we must seek.

Let us examine this table, therefore, in an effort to determine the reason why we do not get the expected negative correlation. First of all, if the various countries under consideration should, when placed in one correlation table, show a definite negative association between the magnitudes and slopes of their birth-death ratios, it would mean that those countries whose magnitudes are high and whose rates of increase are low, were being influenced by factors capable of checking the rate of natural increase. Similarly, those countries manifesting birth-death ratios of less magnitude but with greater rates of increase were not experiencing such influences. Given a heterogeneous group of populations, then, we should reasonably expect them to show the effects of these influences and thereby to give us a significant negative correlation.

the variables; and σx and σy are the standard deviations of the two variables. It measures the degree of association between the two variables, unity being perfect correlation.

The probable error (P.E.) is derived by the formula, $P.E._r = \frac{1-r^2}{\sqrt{N}}$.

A coefficient that is three times its probable error means that odds against such a coefficient occurring from chance are 22.24 to 1.

Negative correlation, the converse of positive, means that as one variable changes in one direction, the other is changing in the opposite direction.

If we examine the countries represented in Table 3, we find that they are composed of different races. For example, there are Asiatics, Europeans, and Latin-Americans. (The Latin-Americans include the races of both Central and South America and adjacent colonies. These peoples possibly have not become distinctly different races as yet, but they may be said to be sufficiently removed from their mother stock to show dissimilar attributes.) We also find that these races are existing under quite different environments. This means that in a given country one race may be permitted to reproduce to a higher degree than another. This is true, for example, of the Australian states, whose birth-death ratio magnitudes are all over 200. In other words, the interaction of environmental and racial factors is operating in different degrees upon the countries involved.

To make the meaning of this point clearer, let us regard as distinct and separate groups the European countries, the Asiatic, the Latin-American, and the Australian states. Thus grouped the various countries are now arranged roughly upon the basis of similar races and environments. If we then place these four different groups together into a correlation table (such as Table 3), we can readily see that the racial and environmental dissimilarity between the groups is too great to make a significant correlation a probable result. If, however, we place the component states or countries of any one of these large groups in a separate, individual, correlation table, we then obtain properly comparable data on the same basic races, existing under similar environments, and may hope to find a significant correlation between magnitude and slope.

With the exception of the Asiatic group, this is actually what we do find.

The coefficients and their probable errors are as follows:

Asiatic group.....	0.056 \pm 0.276
Asiatic group ⁵	-0.365 \pm 0.289
European group.....	-0.286 \pm 0.088
Latin-American group.....	-0.586 \pm 0.182
Australian states ⁶	-0.765 \pm 0.099

Two coefficients have been listed for the Asiatic groups, neither of them significant if measured by its probable error. In the first, Russia, the Dutch East Indies and Japan were included in the calculation. If these countries are excluded, the second coefficient is the result. Russia was excluded because a large part of her vital statistics is based on the European element of her population. The Dutch East Indies data are likewise largely European, as previously pointed out. And Japan was excluded because of her definite environmental advantages over, for example, Hong Kong or the Straits Settlements. When these countries are allowed to remain in the Asiatic group we get about the same absence of significant correlation as when all the groups are placed in one table, as just described. When they are left out of the Asiatic group we get the second coefficient, which shows only an insignificant negative tendency. Here the populations of the few units involved are so small (as in the case of Dindlings, Malacca, etc., and of the Straits Settlements) that minor influences have comparatively much effect, which fact, plus the only suggestive reliability of the figures, is probably accountable for the result. The three remaining coefficients are significant and a brief analytical survey of them is the next step.

First of all, what do the respective coefficients mean? Of what importance are they? It has been stated that a

⁵ Excluding the Russian Empire, Dutch East Indies and Japan.

⁶ Including the Dominion of New Zealand.

negative correlation between magnitude and slope means that there is a limit to which a population can reproduce freely and at the same time maintain an increasing birth-death ratio; that when a population reaches a certain point there appear factors that undoubtedly tend to put the brakes on reproduction, so to speak. These factors, broadly speaking, may be said to be biologic and economic. By the first is meant that inherent virility of organisms which makes it possible for one species to develop beyond another in an evolving universe. Just as there is, among races, an inherited, individual longevity with definitely fixed tendencies, so there is also an individual, inherent ability for self-maintenance. That is to say, one race of people, because of its innate talents (for the want of a better word) or traditions, used in the sense described by Carr-Saunders (9), will adjust itself, grow and multiply, under circumstances where another race might become decadent. Such a statement needs no elaboration. Every one knows from observation that certain peoples require for continued existence that which others find quite unnecessary. This varying capacity for self-maintenance is inherent in races—a biological phenomenon. Slow but continuous, it is believed that a biological damper unquestionably operates with different degrees of potency in all races, but it is of the big inter-racial differences in biological limitation that we are now thinking.

By economic check is meant that limiting force brought about, in general, by relatively poor development in agricultural and industrial activities, and by diminishing natural resources, from whatever causes. The pressure from such conditions operates to diminish the marriage- and birth-rates. Maintenance becomes difficult and the death-rates begin to increase. Japan, a few decades ago, was approaching her limiting point in an agricultural era; with

the development of industries she has subsequently begun increasing again. It is interesting to note in passing that Japan is feeling the pressure of increasing population now. Sanger (67) reports that the government is taking steps to institute a national birth control program. She was told by Dr. Kato, Head of Medical Affairs for the Government, that such a program must be established or, within the next generation, a war of aggression would be inevitable. (The recent devastating earthquakes experienced in Japan will have the effect of postponing, at least temporarily, this probability.) England and Wales, likewise, have shown renewed fertility since the industrial revolution of about a century ago. Perhaps, if France began a complete industrial development, she would improve her reproductive power to some extent. The extent of her improvement would give an index of her true biological vigor. If her present rates of natural increase persist, she is doomed to extinction.

There are of course other limiting factors of more or less temporary character and importance, such as war, famine and epidemics, but they tend more to produce fluctuations than significant secular changes in the general trends of the birth-death ratios.

The European countries, then, occupy different positions in the biological scale of health. Some are showing the effects of the biologic and economic brakes, while others are as yet comparatively untouched. The Netherlands occupy relatively the most prosperous position, with a magnitude of 156 and an increasing slope of 2.2. This is especially interesting in view of Holland's birth control policy. Birth control has been universal in Holland for nearly forty years. Professor Irving Fisher (68) points out the fact that birth control does not mean at all a decrease in population and uses Holland as an illustration.

He further hypothecates three interesting effects that the practice of birth control will have on any population. The first effect, he says, is bad because the voluntary restriction of births is practiced by the intelligent classes; it results in a differential fertility favoring the lower classes. The second effect is a decline in population, as in the case of France, where birth control is probably practiced by all classes; and the third effect, he says, is a rapid repopulation from the small minority of the strongest, most efficient and the most child-loving and altruistic persons in the population. Only time can show whether Professor Fisher is correct. In an article in the *Birth Control Review* (69) it is shown that great improvement in the Dutch race is apparent since the practice of birth control has become universal. For example, when the Dutch army was mobilized the men of military age were 95 per cent efficient by the highest army standards, whereas in the United States, even with a lowered military standard, the men were only 65 per cent efficient. It is also said that the longevity of the Dutchman has increased from forty-six to fifty-one years, figures paralleled only by those of the Scandinavian countries where birth control has also been practiced for years. That birth control is, as claimed, largely responsible for these conditions is highly possible. But it is the writer's belief that there are also other factors, quite as influential, operating toward the same ends.

Returning to the general European picture, we find that, in the main, the other countries occupying favorable positions in the biological scale are again northern. They are Denmark, Germany, England and Wales, Norway, Finland, Belgium, European Russia and Bulgaria, all of them with a magnitude of not less than 140 and an increasing slope of 0.4 or more. Other countries with magnitudes of 140 or more and with slopes less than 0.4

but greater than 0.1 are Scotland and Servia; while those with slopes of 0.4 or more, but with magnitudes of at least 100, are Austria, Hungary, Italy, Ireland, Switzerland, Spain, Rumania and Portugal.

The countries not included for which we have data are France, with a magnitude of 105 and a decreasing slope of 0.006; and Sweden, with a magnitude of 170 and an increasing slope of 0.076. The former country has for over half a century been fluctuating about the 100 birth-death ratio value. In other words, France has been barely maintaining her population by natural increase. It is hardly possible that France, with her size of population, could be materially affected by the amount of immigration or emigration she has experienced. Nor does it seem reasonable to suppose that her vital index curve could be significantly affected by shifting age distributions. Consequently it is evident that France's status is not sound. As intimated before, Sweden's growth has been slow and gradual, as the conditions prevailing there would suggest. Her magnitude is high and her slope is low, suggesting that she is gradually but surely approaching a period of stabilization of her birth-death ratio. Whether or not there will be a plateau followed by another period of increase or by a period of decrease it is difficult to forecast. Empirically, one is inclined to expect another increase. Although the slope is small, the size of the birth-death ratio, even with comparatively low death-rates, certainly does not suggest early decay.

Among the Central and South American units, five have decreasing slopes. Of these, four belong to the British West Indies; the fifth is Guatemala. All these units with decreasing trends show high magnitudes, the lowest being 156. Incipient decay may here be indicated, or the decreasing trends may be due to the large negro popula-

tion—for the negro race appears certainly decadent. The decreasing slopes in these countries may be, however—and in our opinion probably are—relatively insignificant phenomena, due to certain factors that will be discussed later.

St. Lucia, Bermudas, Uruguay and Costa Rica show relatively high magnitudes and slopes, only the second named having a magnitude of less than 150 and all having positive slope values of 0.4 or more. Trinidad has a magnitude of 108 and a slope of 1.8, and Chile a magnitude of 102 with an increasing slope of 0.99. British Guiana and British Honduras have magnitudes of less than 100 with positive slopes of 0.39 and 2.4 respectively. Uruguay stands out in her prosperity with a large magnitude of 216 and a positive slope of 1.3. This country, like the Australian states, which will be discussed later, is still in the developmental stage. Uruguay may be called an agricultural country, her peoples as yet untouched by the more complex modes of living that accompany the industrial stage of development. Agriculture is likewise the principal industry of Costa Rica, where, moreover, there is a relatively small negro population.

We now have a general picture of the Central and South American units. Some, we find, are showing evidence of beginning stabilization and decline, while others are showing splendid growth. The small populations of these countries and their as yet relatively unstable health conditions are probably partially responsible for the wide variety in the pictures they present. It is believed by the writer that populations of comparatively small size, observed over a considerable number of years, show waves, so to speak, of prosperity and deterioration—waves that are but apparent fluctuations in their secular trends. If this is true, then it is possible that the conditions here seen

in the Latin-American countries are only temporarily significant. In another half century or more they may be completely reversed. We shall discuss later the factors that we believe capable of producing waves of this nature and their significance. Unfortunately there are not at this time sufficient figures to prove or disprove this theory, but in the following discussion of Australia, some evidence will be found in support of it.

The Australian states, including the Dominion of New Zealand, are intensely interesting. Two of the units, South Australia and New Zealand, have decreasing slopes combined with the largest magnitudes of the whole group. Now, when we realize that all the Australian units came into existence within forty years of one another; and when we realize that they are composed of essentially the same race, living under practically identical conditions, we are led to ask why there should occur among them so wide a variation, represented by the significant correlation coefficient of -0.785 ± 0.145 . It appears, as suggested above in the discussion of the Latin-American groups, that these units with comparatively small populations must have cycles, as it were, of increase and decrease. Certain levels are reached when something checks the rising curve and, perhaps, sends it down for a few years. When these rising and falling curves for the separate units are combined, the wave-like aspect is lost, and the picture for the Australian Commonwealth as a whole shows a high magnitude and a comparatively uniform, increasing slope of high order. The condition of unrestrained reproduction that has existed in Australia since its settlement by the British probably also accounts to some extent for the wide variation among the states. It is difficult to conceive of any population continuing to increase, like Western Australia, for example, at the speed of 3.1 per year, with

a magnitude of 189, *ad infinitum*. This terrific growth is undoubtedly largely permitted by the virginity of the country which tends to allow free rein to the potential fertility of its people. As the population becomes more commensurate with the country's supportive capacity, the birth-death ratio curve will unquestionably seek a uniformly increasing level in accordance with the innate biological healthiness of the population.

That the two states, South Australia and New Zealand, with decreasing trends, have reached their limits, biologically speaking, is difficult to believe. If they have reached their limits, then why have not the other states, which are essentially of the same stock? Nor is it reasonable to suppose that the declining slopes are due to economic pressure. There must be some other reason for the rising and falling trends, for the wave-like phenomenon we have already called attention to.

Now a decreasing slope means a declining birth-death ratio. A birth-death ratio is lowered in two ways: by a diminishing number of births, the deaths remaining approximately the same; and by an increasing number of deaths, the births remaining relatively constant. A vital index slope rises when these conditions are reversed. (It should be stated that the birth-death ratios here have been computed from actual numbers and not from rates.) We may now ask: What factors operate to lower the number of births in a given population? In general, a multiplicity of factors, but, omitting for the moment the underlying economic and biological factors, the principal ones are: (a) a decreasing population of the reproductive ages; and (b) a shifting age distribution of the population favoring the older ages. A distorted sex ratio favoring males might conceivably play a part, but it can scarcely be counted a factor because of the tremendous distortion that must occur

before its effects are felt. The number of deaths may increase because of: (a) unstable health conditions due to general laxity in sanitation or ignorance of the broad principles of preventive medicine; or (b) a shifting age distribution favoring the older ages; or (c) an increasing population of the older ages. Conversely, a birth-death ratio may be raised by an increased number of births through: (a) a growing population of immigrants of the reproductive ages; or (b) through a shifting age distribution favoring the reproductive ages. And a birth-death ratio may be raised by a decreased number of deaths through: (a) shifting age distribution favoring the younger ages; or through (b) the application of the general principles of sanitation and preventive medicine.

It is not contended that these factors affect large populations perceptibly. But it seems reasonable to believe that their influence can be seen in smaller communities. In larger populations the effect of these minor factors is balanced, so to speak, although it is conceivable that they might assume such proportions as to make perceptible impressions even on larger populations. Unless they are of impressive magnitude, however, their effects are swallowed by the greater factors of a biologic and economic nature with which the smaller forces are practically always related in a more or less compensatory fashion.

Looking now at the states of Australia, we find that first of all they have been invaded by young immigrants. In the ten years, 1881 to 1890, that cover part of the time over which the birth-death ratios are computed (1885 to 1913), there were 382,741 (244,284 males and 138,457 females) more arrivals than departures. Immediately afterwards, in 1899 and 1900, the war in South Africa caused an excess of 10,546 departures. Subsequently, the net immigration has steadily increased. Internally, we

find that there has been much shifting about of the population. The discovery of gold in 1851 brought an increase of 740,229 to Australia, principally to New South Wales and Victoria. In 1861, when the gold fields in New Zealand were opened, there was a rush of the population from Australia. Again, in 1886 and subsequent years, gold discoveries were made in Western Australia which caused an extensive migration to that state at the expense of most of the Eastern states. Another cause of the internal shifting in the Commonwealth's population is the intermittent droughts, more or less common to Australia. Knibbs (60) writes: "The droughts, which at times so seriously affect the agricultural and pastoral prospects of Australia, have a marked influence on the distribution of population. Districts, which in favorable seasons are fairly populous, occasionally in time of drought become more or less depopulated until the return of better conditions. This movement, however, ordinarily affects only the internal distribution of the population, and not the total, but severe drought may make its influence felt in the statistics of the total population of Australia. Thus in the case of the drought of 1902-1903, the departures from the Commonwealth exceeded the arrivals for the years 1903 and 1904 by 12,859. It may be noted also that for the former of these years, the natural increase of population by excess of births over deaths was abnormally low, being only 51,150 as compared with 54,689 in the preceding and 60,541 in the succeeding year."

In order to see the distribution of ages, Table 4 is presented. The figures are for the Commonwealth, covering the years from 1861 to 1911 inclusive. They are taken from the Official Year Book of the Commonwealth of Australia (60). To give an idea of the age distribution of the various states of Australia, Table 5, showing this dis-

tribution for the years 1901 and 1911, is included. And, for the purpose of comparison, Table 6, showing the same

TABLE 4

Showing the age distribution for the years 1861, 1871, 1881, 1891, 1901, and 1911 for the Commonwealth of Australia

YEAR	UNDER 15	15 AND UNDER 65	65 AND OVER
1861	36.28	62.72	1.00
1871	42.09	56.17	1.74
1881	38.91	58.65	2.44
1891	36.90	60.20	2.90
1901	35.12	60.88	4.00
1911	31.65	64.08	4.27

TABLE 5

Showing the age distribution of the states of Australia for the years 1901 and 1911

	YEAR 1901			YEAR 1911		
	UNDER 15	15 AND UNDER 65	65 AND OVER	UNDER 15	15 AND UNDER 65	65 AND OVER
New South Wales.....	35.94	60.62	3.44	31.98	63.97	4.05
Victoria.....	34.08	60.42	5.50	30.42	64.44	5.14
Queensland.....	36.62	60.79	2.59	33.01	63.28	3.71
South Australia.....	35.59	60.30	4.11	31.15	64.22	4.63
Western Australia.....	28.93	69.26	1.81	31.15	66.49	2.36
Tasmania.....	37.12	58.81	4.07	34.89	60.98	4.13

TABLE 6

Showing the age distribution of England and Wales for the years 1901 and 1911

	UNDER 15	15 AND UNDER 65	65 AND OVER
1901	32.42	62.91	4.67
1911	30.63	64.16	5.21

age distribution for England and Wales for the years 1901 and 1911, is added.

It will be noted from these figures how the different

states vary in the percentage of age groups represented, as compared with the Commonwealth of Australia and with England and Wales. The small percentage of the ages of sixty-five and over, in the case of Australia, is significant; and the gradually increasing number of these groups from 1861 on is especially noteworthy in the light of what has been said above.

From the foregoing evidence, we feel that it may safely be assumed that a shifting population with accompanying alterations in the age distributions may exert a sufficiently powerful influence on the birth-death ratios of relatively small populations to produce periods or waves in the curves. An influence of this sort may conceivably be great enough to affect larger populations but there is no present evidence of such an effect in our world to-day except in the case of the Australian Commonwealth, and, to some extent, in the case of Ireland.

From the information now assembled, the relative conditions of the several Australian units can be summarized. Victoria and New South Wales, with positive slopes of 0.15 and 0.97 respectively, give evidence of "settling down," as it were, to steady growth. Victoria has a population density of nearly three times that of New South Wales, the latter state being still only sparsely populated. These states grew rapidly after the first gold rush in 1851. South Australia and New Zealand show high magnitudes and decreasing slopes, which suggests a reaction to rapid growth. This is especially true for New Zealand where a reaction would be expected after the rush to her gold fields in 1861. In that year the departures from Australia exceeded the arrivals by 6283. Tasmania and Queensland are enjoying a rapid increase. The latter state has shown a more or less steady growth with a population density one-sixteenth that of Victoria. Tasmania suffered a re-

tardation in 1852 and the following years, due to the rush of her population to the mainland in response to gold discoveries there. The positive slope of 2.14 is probably a compensatory increase to the retardation. Western Australia, with the lowest percentage of individuals over sixty-five years of age, and with the highest percentage in the reproductive years, is increasing at the enormous rate of 3.1. This high rate of increase is no doubt a result of the gold rush of 1886 and later discoveries of gold in 1891 and 1892. The population density is one-fifteenth that of Victoria. Western Australia will probably, in the course of a few decades, reach a point where her rapid reproduction will cease, perhaps show a wave of complementary decrease, and then begin again a uniform increase.

We have found that the Australian states show varied trends of natural increase. In the time interval 1885 to 1913, some of them show declining slopes while others are in a stage of great increase. And it appears to be true that this variety is due to unusually rapid and powerful changes within the populations; that is, the variations are of a spasmodic nature rather than slow, uniform trends. Having discovered factors capable of bringing about these wave-like trends in the Australian states, it seems logical to look for the operation of similar factors in other small populations, even though they may not have experienced precisely the same stimuli—gold discoveries, etc. In other words, any more or less homogeneous population, when subdivided into smaller units, should give a significant negative correlation between slope and magnitude of the birth-death ratios, produced by a slow but definite shifting of populations with consequent alterations in age distributions. Other minor influences will, of course, also play a part and all the factors may be associated directly and measurably with the more imposing biologic and economic causes.

In order to determine whether this statement will hold, the magnitude and slope values of the German states have been correlated. The resulting coefficient of correlation and its probable error are: -0.67 ± 0.07 . There are four states in the German group with decreasing slopes. The great majority, however, show values indicating a high fertility. Sixteen of them have positive slopes of 0.5 or more with magnitudes of not less than 145, while five show magnitudes of 125 or more with increasing slopes of not less than 1. Since the magnitude for Germany as a whole is 145 and the slopes is 1.33, it again becomes evident that the internal variation is but an expression of wave-like trends within its twenty-six states. These waves are caused by minor influences capable of changing, temporarily, the vital index curves of small populations.

That these results might well be explained on economic grounds is thoroughly appreciated by the writer. We have indeed already said that it is our opinion that all such changes are ultimately traceable to economic influences, using the term, economic, comprehensively. But we believe that economic conditions are less variable within the subdivisions of one country than they are among the different countries of the world. The economic influences, therefore, have been arbitrarily chosen to apply to the countries or larger populations, and the so-called minor influences have been taken to explain the cyclical phenomena of subsidiary communities. The minor factors have their not very remote antecedents in the greater, economic factors, but they act more immediately and may, indeed, be taken as a part of the effect produced by the economic influences.

There remains one interesting point to be investigated. If we consider now our four racial groups, irrespective of the individual states comprising them, we may make a

comparative study of the relative biological status of the races represented. It is evident that the four groups have different average magnitudes and are increasing at different speeds. We desire to know what ultimate magnitude each group is capable of attaining. Under the circumstances prevailing over the time span 1885 to 1913, what is the end point of the reproductive capacity of each group? At what value will the birth-death ratio become asymptotic? Or, putting it another way, when the slopes become zero, what will be the average magnitude of the vital index of each of the racial groups? This can be determined by finding the regression equation relative to the magnitudes of the component units of each group when the slopes are at zero. This simply amounts to fitting a straight line to the points y on x , y being the magnitude variable and x the slope variable in the correlation tables, and finding what the values of the magnitudes are when the lines cross the zero axis. The results are as follows: Australian group (including the Dominion of New Zealand) 255.3, ± 1.41 ; German states, 165.6, ± 1.25 ; European group, 156.4, ± 2.35 ; Latin American group, 161.9, ± 2.32 ; and Asiatic group, 81.0, ± 2.14 . Evidently these groups possess different *average* magnitudes at zero slopes.

The Australian group may reproduce to the magnitude of 255.3, which is not significantly greater than her magnitude for the year 1921 (252.0). It seems evident therefore, taking into consideration the probable error of the average magnitude, that Australia has virtually reached her maximum natural increase rate under present conditions. What the adjusted magnitude and rate of increase will be remains to be seen. Indications are that they will remain relatively high for some time to come but with a gradually decreasing positive slope. It is also thoroughly possible that the birth-death ratio trend will

show a definite downward slope for a few years until the natural or "normal" level is reached, when the slope will again become positive but will be characterized by a less variable trend.

Germany, as a country, according to the figure just shown, has reached her limit of reproduction under the conditions that prevailed up to 1913. Her value at 1885 was 147 and in 1913, 185. The latter figure, however, is undoubtedly affected by the rapidly increasing larger states. Prussia, Bavaria, Saxony, Württemberg, Baden, Hesse, and Alsace-Lorraine have slopes of 1.5, 1.5, 1.3, 1.6, 1.6, 2.0 and 1.0 respectively. The maximum or average magnitude of 165.6, however, is not so weighted, being affected as much by the states with decreasing slopes and by the smaller states as by the rapidly increasing units. It appears fairly certain, then, that unless conditions are altered, the larger states are doomed to become less prolific. It is interesting to observe that the World War happened just at this stage of Germany's development.

Europe as a whole, with an average magnitude at zero slope of 156.4, must be pretty close to her population limit. Certain of the countries included have already exceeded the limit, others have not. Some of the European countries are avoiding an excessive population by steady emigration and are thus maintaining more or less high vital indices. Germany has been thwarted in her attempt to expand, which leaves England and Wales, France, Italy and Russia, of the larger countries, in more or less contending positions. If the pre-war rates of natural increase continue now, unless some other solution is forthcoming, another European war for the acquisition of territory seems inevitable.

The zero slope magnitude for the Asiatic group is below 100. The insignificant correlation in this group and the

fact that the vital statistics for the units comprising it are questionable, make speculation dangerous.

The Latin-American group shows an average magnitude of 161.9, higher than that for Europe. The comparative virginity of these units is probably one reason for the difference. The people are in the main basically European, although, as we have already pointed out, they are sufficiently removed to be differentiated. The melting pot to which Spain, Italy, Portugal, Germany, France and England have contributed, is yielding, apparently, a relatively fit product. The question of the reliability of the vital statistics of the Latin-American units must be borne in mind when considering these results.

From the preceding comparisons we get a general picture of the relative trends of the four different groups. It must be remembered that the magnitudes and slopes of each country and states have been computed over a period of twenty-nine years. Also that the average magnitudes of the four groups *are* but averages, and should, therefore, be taken only as indicators of their general developmental trends.

The results of the preceding discussion of the magnitudes and slopes may now be summarized.

1. There appears to be a distinct and significant correlation between the size of a birth-death ratio and the rate of its increase. The meaning of this relation is that populations are subject to limiting factors which tend to lessen natural increase at certain levels and under certain conditions. These limiting factors have been called (a) the biological damper, or the innate racial talents or traditions that determine the reactions of different races to different environmental conditions and (b) the economic factor. The writer realizes that these are broad and in a sense vague terms, but they are convenient ones and, ultimately,

undoubtedly account for the significant correlations that exist. To apply them separately to any single population would, of course, be almost impossible. As checks, they operate in some degree on all populations and, from the nature of the case, they necessarily operate together. The reader has doubtless concluded by this time that, if these checks exist, and if they operate sufficiently effectively at present to account for the significant correlation found, there remains no such thing as a population question. But this inference is by no means sound. If these checks had not been operating in the past, what would our populations be today? They will continue to operate as long as there are populations. And it is precisely their operations, which will become more important as numbers continue to increase, that define the population question and make it realizable. Moreover, in spite of these checks, the natural increase of populations continues its upward trend—and this is the important fact. Most of the populations are going to increase naturally because they are biologically fit, and they will ultimately face the question in its reality. It might better be said that the biological and economic dampers are more like governors or regulators than actual checks. If they were more potent we should probably find a higher degree of correlation among the larger homogeneous populations. We need but observe the magnitudes of the birth-death ratios and the high rates of increase in most of the countries, and think of the population question as we now understand it, to appreciate to what a small extent the biologic regulators act as material checks.

2. The effect of the practice of birth control on these correlations suggests interesting speculation. Although its effect is intangible and difficult to estimate, it seems reasonable that perhaps no small bit of the coefficients'

significance may be attributable to the voluntary restriction of births. The practice is unquestionably a means of reducing the rates of natural increase. One's mind immediately turns to Holland which, as pointed out, presents a picture of biological vigor. But it should be remembered that the practice there is universal, regulated, and under intelligent control, whereas in most countries it is practiced by certain classes only and without regulation. This condition amounts to a differential restriction. It tends to decrease the birth-rate in classes where the death-rate is low, while, among the proletariat, where a relatively higher death-rate prevails, a high fertility is maintained.

3. There are cycles of increasing and decreasing birth-death ratios in small populations that are largely the result of changes in the constitution of the populations and shifting of the age distributions, changes that may or may not be directly associated with, or an immediate result of biologic and economic factors.

4. The peoples of the northern European countries, Australian states, and Uruguay possess the greatest fertility as judged from the magnitude and slope values. In other words, these populations are biologically the healthiest.

5. With the possible exception of the Latin-American group, the four racial groups have reached their *average* maximum birth-death ratio magnitudes. Under prevailing conditions, Australia will probably maintain a high magnitude, possibly with a slight increase, and the same future may be prophesied for the Latin-American countries. If the figures we have may be considered indicative, the Asiatic group is doomed to gradual extinction. In 1913 the European countries as a whole had exceeded their average magnitudes, a condition which, in the light of the War, gives rise to reflection. The losses in the conflict

will be compensated by a reincreased reproduction, with what result, under present circumstances, is a subject for speculation.

Before discussing the effect of war and disease upon the population status of different countries, we shall attempt to make clearer the significance of the birth-death ratio as a true index of population increase or decrease. For this purpose we shall compare the observations of Newsholme and Stevenson with our own and with those of Sir J. A. Baines on the status of the populations of Europe and other countries. Newsholme and Stevenson, writing on "The Decline of Human Fertility in the United Kingdom and Other Countries as Shown by the Corrected Birth-Rates" (18), find that Ireland is the only country among those considered that shows an increased fertility over the twenty-two years studied. They add: "Denmark has evidently traveled much further on the road of declining birth-rate than Sweden, and still further than Norway. In Scotland the decline has been nearly as great as in England, but England's actual position is much lower than that of Scotland. The greatest decline of all is shown by New South Wales; Victoria, Belgium, and Saxony coming next, and then New Zealand." Classifying the countries according to the percentage decline of total annual birth-rate over twenty-two years, the authors find that "New South Wales comes first with a decline of 32 per cent, Victoria next with a decline of 25 per cent, then Belgium with 24 per cent decline. Saxony 23 per cent, New Zealand 19 per cent, and England and Wales 18 per cent. The smallest decline occurred in Austria—1 per cent, Norway and Sweden 6 per cent, and Italy 9 per cent. Ireland showed an increase of 3 per cent."

Consulting our figures on the countries studied by Newsholme and Stevens, we find that New Zealand, which

they found to be fifth in the scale of decline, had the highest birth-death ratio for the year 1885 and also, incidentally, for the year 1913 as well. New South Wales, found by the English writers to show the greatest per cent fertility decline, we found to have the second largest birth-death ratios for the years 1885 and 1913. The other countries in the order of their birth-death ratio magnitudes for the year 1885 are: Victoria, Norway, Sweden, Scotland, England and Wales, Denmark, Belgium, Saxony, Italy, Austria and Ireland. Listed in order according to the size of the vital indices as predicted by the straight lines for the year 1913, they are: Victoria, Denmark, Norway, Saxony, England and Wales, Sweden, Scotland, Italy, Belgium, Austria and Ireland. (If the actual, observed indices instead of the predicted for the year 1913 are taken, the only change would be a shift in the relative positions of Scotland and Italy.) It will be noted that on the basis of the corrected birth-rates, Ireland was found to show increased fertility and Austria the smallest per cent decrease.

Even more significant, however, is a comparison of the *rates* of increase in the birth-death ratios with the figures on fertility decline. Denmark, whose decline in fertility was found to be greater than either Norway or Sweden, we find to show the greatest rate of natural *increase* over all the countries studied. On the basis of the corrected birth-rate, New South Wales showed the greatest fertility decline, but she ranks third in the scale of natural increase, Saxony being second. Austria shows the fifth highest rate of increase; England and Wales are sixth; and Ireland and Norway share the honors of the seventh place. New Zealand is the only country we found to show a decrease in the rate of her birth-death ratios and Victoria and Sweden show the smallest positive rates of natural increase.

These comparisons are only to show that birth-rates in themselves do not indicate the actual condition of a population. A reader not familiar with the actual conditions of Ireland or New South Wales, for example, when told that the former's fertility was increasing and the latter's decreasing, might assume the respective populations to be increasing and decreasing accordingly. This is obviously not the case. Regardless of the trends of fertility, as shown by the corrected birth-rates, we find that all the countries but one are actually increasing in population. It is hoped that this comparison may make clearer to the reader just what the vital index measures.

Sir J. A. Baines (70) in a paper published in 1909 on the "Recent Growth of Populations in Western Europe" obtains results closely similar to our own. Baines includes sixteen countries in his study of the natural increase in Western Europe. Speaking of a high birth-rate accompanying a high death-rate, he says: "This can be seen in the case of Austria, Spain, Italy and Germany, and the converse in Sweden, Norway and most of the other Scandinavian tracts, in all of which, except Finland, the low birth-rate is accompanied by a comparatively low rate of deaths. The general result is to place all these countries except Sweden very high in the serial order of natural increase. Germany, which from seventh in the 'seventies, stands third in the 'nineties, won its position by persistence in outbreeding its high mortality. The same was the case in Holland at the earlier period, though later, owing to the decline in the death-rate, it stands first in the relative excess of its births. England has changed places with Germany, because the decrease in its mortality has been outweighed by its still more decreasing birth-rate. Sweden and Ireland are other instances of the neutralization of the increase which would naturally follow a low mortality by a

still lower birth-rate, and France, whose natality would in any case keep it at the bottom, is burdened, in addition, by a death-rate which is only excelled by four others. It is interesting to look at these positions in the light of the fecundity-rate, but I can go no further than to point out that Holland stands first in both natural increase and fecundity; Norway, Finland, Scotland, Italy and Germany occupy pretty well the same rank in regard to both rates, whilst England and Sweden are only buoyed up by their low mortality."

Baines lists the countries with their measures of natural increase. For this measure he uses Rubin's D^2/B , taking the reciprocals from 1,000 in order to make them readily comprehensible. The countries fall into the following order: Norway, Sweden, Denmark, England, Scotland, Finland, Holland, Ireland, Belgium, Portugal, Switzerland, Germany, Italy, France, Austria, and Spain. He makes the following remarks about the list: "The order seems in general harmony with the tenor of the statistics I have been reviewing, though the position of Ireland and Portugal may appear somewhat anomalous. But we are here dealing with vital statistics only, and not with economic and other considerations, which would probably entail, if introduced, considerable modification. I would just remark, in passing, that the remarkably high rates of birth, death, and marriage in Eastern Europe place those countries below nearly all those in the west. At the other side of the world, the low death-rate and high birth-rate of the Argentine give that country the figure of 932, above Norway. Going further afield, this is beaten by the Australian Commonwealth, which, mainly through its low death-rate, obtains 941. The climax is reached in New Zealand, where a death-rate of 10 indicates the nearest approach to immortality yet on record, and imparts to a

comparatively low birth-rate the borrowed lustre of 963 points!"

It is interesting to note that, while the methods used by Baines are slightly different from ours and the time periods studied are even more at variance, his results are nevertheless strikingly similar to the figures set forth in this study. In fact, they are in general identically the same.

CHAPTER VI

THE EFFECT OF WAR AND PESTILENCE

It is widely believed that highly destructive wars and exacting pandemics have an almost unrecoverable effect upon the populations of nations. Such catastrophes are believed to cause so profound a disruption of the vital phenomena of births and deaths as to check materially a population's growth. From the standpoint of a statistical study, it is fortunate that the World War culminated with the appearance of the influenza pandemic. Both exacted literally millions of lives and we are presented with an excellent opportunity of examining the depopulating effects of these ravages as indicated by the vital indices of the various populations.

Pearl (6) in a paper published in 1920 noted the effect of the war on the chief factors of population change in the case of four belligerents—France, Prussia, Bavaria, England and Wales. The figures included, however, only the years 1913 to 1916 inclusive. He showed that there was a marked reduction in the vital indices during the war years. The trends of the first mentioned populations (their vital indices) were about parallel while England and Wales showed trends that were less steep. The British population, however, showed a more marked reaction than the others to the influenza epidemic. At the close of the paper, the author remarks that information would be welcome on two points. The first point is: "What will be the course of these birth-death ratio curves in the years following 1918? Will they come back to the pre-war level, and if so, how soon?" He adds that England and Wales showed a tendency to come back in 1919 but did not reach

the pre-war level. "In the second place," Pearl writes, "one would like to know what the appearance of the curve for the United States would be." An attempt will be made to throw some light upon these points in the following pages.

About two years later, the same author, Pearl (71), writes that "neither a highly destructive war (like the world war) nor the most destructive epidemic since the middle ages serves more than to cause a momentary hesitation in the steady onward march of population growth!" To this view we see disagreement arising. Professor Willcox (15) in a paper, "Population and the World War," quotes the above statement and adds: "I see no convincing reason to believe in regular curves of growth or population orbits susceptible of representation by mathematical equations through the help of which it is possible to forecast the future growth of populations." Referring then to the mathematical representation of growth as evolved by Pearl and Reed (72), he adds that if there is a formula to predict a population growth it should fit the past as well as the future; and chooses France to which he applies the formula as far back as 1328. He finds an increasingly large difference between the resultant figures and Levasseur's estimates. From this he infers that a prediction for the future would be just as inaccurate. Then he remarks, "My scepticism goes deeper. I do not believe in the existence of any simple law of population growth. I do not believe that population grows smoothly and steadily, but rather that the line symbolizing its growth contains inflexions or angles."

From these remarks it is apparent that Professor Willcox is not thoroughly familiar with the law of population growth as proposed by Professors Pearl and Reed. The fact that his application of the formula of population

growth to France did not coincide with Levasseur's estimates does not in the least invalidate the law; instead, it is further evidence that he is not acquainted with all that the authors of the law have written upon the subject. Professor Willcox has chosen an equation expressing a single epoch or cycle of growth and applied it to France, regardless of the fact that France has experienced more than one period of growth. The United States population growth can be well fitted by this equation because the United States has experienced thus far only one growth cycle. France, on the other hand, had an earlier period of growth that the chosen formula does not include. This point can best be clarified by quoting from a paper by Drs. Pearl and Reed (73). They write: "Having determined that the growth within any one epoch or cycle may be approximately represented by equation (i),¹ or more accurately by (vi),¹ the next question is that of treating several epochs or cycles. Theoretically, some form of (v)¹ may be found by sufficient labor in the adjustment of constants so that one equation with say 5 or 7 constants would describe a long history of growth involving several cycles. Practically, however, we have found it easier and just as satisfactory in other respects to treat each cycle by itself. Since the cycles of any case of growth are additive, we may use for any single cycle the equation

$$y = d + \frac{k}{1 + me^{ka'x}}$$

or more generally

$$y = d + \frac{k}{1 + me^{a_1x + a_2x^2 + a_3x^3}}$$

where in both of these forms d represents the total growth attained in all the previous cycles. The term d is therefore

¹ See reference (73) for formulae referred to.

the lower asymptote of the cycle of growth under consideration and $d + k$ is its upper asymptote.

"In treating any two adjacent cycles, it should be noted that the lower asymptote of the second cycle is frequently below the upper asymptote of the first cycle, due to the fact that the second cycle is often started before the first one has had time to reach its natural level. This for instance would be the case where a population entered upon an industrial era before the country had reached the limit of population possible under purely agricultural conditions.

"The theory presented in this paper has been found to be entirely successful in fitting the population growth of many different countries"

It is, of course, understood that any population curve will show fluctuations produced by various causes. For this reason any prediction is subject to a probable error. The more remote the prediction, the larger becomes the probable error, which, however, can also be predicted. The population growth curve is, therefore, a prediction of the actual trend and growth of a population. Essentially the same trend is followed by all growing populations and it can thus be resumed in mathematical formulae as a law of population growth.

It has been shown above that Pearl and Reed, in evolving their law of population growth, recognize the fact that some populations manifest more than one epoch of growth, as is true in the case of France. This is obviously where Professor Willcox went astray in his handling of France's population. Had he realized this point and had he applied to France one of the formulas including previous growth, he would have arrived at results very different from those set forth in his paper. Once the law of population growth is better understood, it is difficult to consider seriously Professor Willcox's scepticism.

Let us now see whether Pearl's statement quoted above and treated sceptically by Professor Willcox is true: that is, whether or not the World War and the influenza pandemic have actually caused more than a momentary hesitation in the steady onward march of population growth.

In order to get a rough impression of the effect of the war years and the influenza pandemic upon all the countries for which we have figures, Table 7 has been prepared. For these countries are listed the means with their probable errors. In the first column the means include the years 1914 to 1920, in some instances to 1921. (In a few instances one or two of the intervening years is missing because of the absence of data, and the omission noted.) The means in the second column are computed from the birth-death ratios up to and including the year 1913. It will, of course, be kept in mind that, since the time interval involved varies considerably, the figures for the different countries are in no way comparable. The table is interesting only in noting the effect of including the years following 1913 as compared with the means up to that date. Since in some cases data for one or more years may be missing from the war and post-war periods, the figures must be taken as only suggestive.

In Table 8 are listed the predicted and observed birth-death ratios of nine of the belligerent European nations for the year 1913 and their observed birth-death ratios for 1920. At the foot of the columns are the *weighted* average birth-death ratios for the same years. From these figures it is evident that the warring countries not only showed a compensatory reaction to the five years of devitalizing experiences, but that they actually returned in full measure to the pre-war and pre-influenzal level of their natural increase,—and *within two years time!* Does this not

TABLE 7

Showing the means and their probable errors including the war and influenza years and excluding these years for all countries possessing one or more year's data beyond 1913

COUNTRY	MEANS INCLUDING YEARS 1914-1920		MEANS EXCLUDING YEARS 1914-1920	
Hong Kong.....	24.7	±1.0	25.0	±1.1
Singapore.....	54.4 ¹	±1.8	48.2	±0.9
Penang.....	56.3 ¹	±1.9	51.0	±1.2
Straits Settlement.....	70.3	±1.6	65.4	±1.1
Dindlings.....	96.0 ¹	±2.9	101.0	±3.0
Malacca.....	101.4 ¹	±2.3	103.8	±2.6
British Guiana.....	102.3	±3.3	102.9	±3.7
Mauritius.....	102.8 ²	±2.1	102.7	±2.1
France.....	104.0	±1.4	107.7	±0.9
Wellesley.....	104.7 ¹	±1.8	107.0	±1.8
British India.....	111.6	±2.1	112.5	±2.0
Fiji.....	113.5	±4.8	100.8	±2.8
Chile.....	123.8	±1.8	121.7	±2.1
Spain.....	127.0 ³	±1.5	127.2	±1.6
Ceylon.....	127.5	±2.7	126.4	±3.1
Hungary.....	129.3 ⁴	±1.8	131.4	±1.7
Venezuela.....	131.9	±2.2	135.0	±3.0
Austria.....	133.1 ⁵	±1.8	135.9	±1.1
Gibraltar.....	135.0	±2.3	137.0	±1.2
Trinidad.....	135.9	±1.8	134.6	±2.0
Ireland.....	136.2	±1.2	137.3	±1.3
Barbados.....	136.5	±3.3	140.0	±3.8
British Honduras.....	137.7	±3.1	137.2	±3.4
Italy.....	140.3 ³	±1.9	141.8	±1.4
Rumania.....	140.5 ⁶	±2.3	142.4	±2.7
Switzerland.....	144.2	±1.4	145.2	±1.3
Sweden.....	144.2	±1.3	144.0	±1.3
Cape of Good Hope.....	145.0	±3.2	150.8	±2.6
Belgium.....	145.9 ⁷	±2.3	149.2	±1.2
Bavaria.....	147.0 ⁸	±1.6	147.1	±1.7
Japan.....	148.1 ³	±1.4	147.7	±1.6
Saxony.....	150.5	±3.6	160.8	±1.9
Portugal.....	150.7 ¹	±2.0	150.8	±1.5

¹ 1920 missing.

² 1918 missing.

³ 1921 included.

⁴ 1918 and 1919 missing.

⁵ 1915, 1916, 1917 and 1920 missing.

⁶ 1916 and 1917 missing.

⁷ 1914 and 1915 missing.

⁸ 1915-1920 inclusive, missing.

TABLE 7—Continued

COUNTRY	MEANS INCLUDING YEARS 1914-1920		MEANS EXCLUDING YEARS 1914-1920	
Dutch East Indies.....	151.3 ⁹	± 3.0	145.6	± 2.8
Württemberg.....	151.8 ¹⁰	± 2.4	155.0	± 1.8
Hamburg.....	153.6 ¹¹	± 3.0	157.5	± 2.6
German Empire.....	157.5	± 2.8	163.5	± 2.1
Bermudas.....	158.8	± 3.0	155.9	± 3.4
Prussia.....	159.6 ¹	± 3.6	170.4	± 2.3
Bulgaria.....	160.2 ⁹	± 4.8	165.4	± 3.8
England and Wales.....	161.3 ³	± 1.1	162.1	± 1.0
Finland.....	163.2 ¹	± 2.2	168.6	± 1.5
St. Lucia.....	163.4 ²	± 1.8	162.2	± 2.2
Scotland.....	163.9 ³	± 1.1	164.8	± 0.8
Jamaica.....	165.0	± 2.4	170.0	± 1.8
Costa Rica.....	166.0	± 3.4	167.3	± 3.8
Bahamas.....	169.5	± 3.2	166.2	± 3.1
Bremen.....	170.0 ¹²	± 2.1	173.7	± 1.6
Newfoundland and Labrador...	176.2 ¹³	± 3.2	175.8	± 2.8
Netherlands.....	179.4	± 2.3	176.1	± 2.3
Denmark.....	180.3 ³	± 1.6	178.4	± 1.8
Norway.....	187.3	± 1.4	188.5	± 1.2
Lippe.....	188.9 ¹⁴	± 3.5	193.4	± 2.3
Grenada.....	190.4	± 2.3	190.6	± 1.8
Victoria.....	210.0	± 1.9	210.4	± 2.1
Argentine Republic.....	210.0	± 2.4	210.4	± 2.8
Uruguay.....	230.1	± 2.4	234.4	± 2.4
Western Australia.....	237.1	± 5.1	230.5	± 5.5
Australia.....	239.2 ³	± 2.1	237.0	± 2.1
South Australia.....	251.8	± 2.5	253.2	± 2.8
Queensland.....	253.9	± 4.2	254.0	± 4.8
Tasmania.....	255.2	± 3.1	248.1	± 3.0
New South Wales.....	255.6	± 2.6	255.5	± 2.6
New Zealand.....	286.9	± 3.8	291.6	± 3.6
Falkland Islands.....	308.8 ¹	± 18.4	310.3	± 18.3
United States.....	176.1 ^{15,16}		173.5 ^{17,16}	
Canada.....	200.4 ^{3,16}		200.7 ^{18,16}	
Dutch East Indies.....	143.1 ¹⁶		122.2 ^{18,16}	

⁹ 1919 and 1920 missing.¹⁰ 1914, 1915 and 1916 missing.¹¹ 1914, 1915, 1916 and 1917 missing.¹² 1914, 1916, 1917 and 1918 missing.¹³ 1918, 1919 and 1920 missing.¹⁴ 1914, 1915, 1916, 1917 and 1919 missing.¹⁵ 1921 and 1922 included.¹⁶ Averages.¹⁷ Based on two observations.¹⁸ Based on three observations.

indicate a "steady onward march of population growth?" And does not the almost immediate compensatory reaction bespeak but a "momentary hesitation" in this onward march?

In order to get a more general picture, those countries whose birth-death ratio trends were fitted with straight lines and that have data extending beyond 1918 have been chosen and tabulated in Table 9 with their pre-

TABLE 8

Showing the predicted and observed vital indices of the belligerent European nations for the year 1913 and the observed ratios for the year 1920, with the weighted averages for each year

COUNTRY	PREDICTED VALUE	OBSERVED VALUE	OBSERVED VALUE
	1913	1913	1920
Rumania.....	163	162	126
Italy.....	161	169	169
Germany.....	185	183	171
England and Wales.....	178	174	196
Austria.....	153	146	118
Hungary.....	149	150	145
France.....	105	106	124
Belgium.....	158	151	160
Scotland.....	170	165	200
Weighted averages ¹	160	160	160

¹ Weighted on the basis of the populations in millions in the year 1919.

dicted and observed values for the years 1918, 1919, 1920 and 1921. Here the compensatory reaction may again be studied and also, by comparing the observed with the predicted indices for the year 1918, the culminating destructive effect of the influenza year may be noted. The behavior of the individual countries, though interesting, will not be commented upon but left to the reader to study and make his own comments. What we are interested in primarily is the aggregate population. It should

TABLE 9

Showing the predicted and observed vital indices for the years 1918, 1919 1920, and 1921 for all the countries that were fitted with straight lines and possessed data for one or more of the above years

	1918		1919		1920		1921	
	Pre- dicted	Ob- served	Pre- dicted	Ob- served	Pre- dicted	Ob- served	Pre- dicted	Ob- served
Rumania.....	168	35	169	109	170	126		
Portugal.....	163	72	164	109				
Finland.....	180	84	181	106	182	162		
Japan.....	176	120	178	139	179	143	180	156
Spain ¹	153	88	155	121	157	126	158	142
Sweden.....	172	113	172	136	172	177	173	173 ²
Norway.....	197	146	198	164	198	211		
Dutch East Indies.....	162	154	162	187				
Holland.....	229	145	231	183	233	239	235	246
Italy.....	165	56 ³	166	112 ⁴	167	169	168	174
Bremen.....			193	125	194	166	195	185
Prussia.....	202	60	203	128	205	167		
Saxony.....	189	48	190	122	192	192	193	186
Württemberg....	190	82	191	140	193	178	194	170
Hamburg.....	178	62	179	110	180	152		
Lippe.....	226	58			225	184	227	186
Germany.....	191	58 ⁵	193	129 ⁶	194	171 ⁷	195	176 ⁸
Western Australia.....	291	251	294	193	297	240	300	224
New South Wales	271	269	272	184	273	258	274	273
Tasmania.....	291	293	294	242	296	282	298	262
South Australia ⁹ .	237	259	237	202	236	237	235	240
Victoria.....	210	208	210	163	210	215	210	220
Australia.....	250	250	251	185	252	242	252	252
Hong Kong ⁹	14	17	14	19	13	20	12	30
Mauritius ⁹			96	53 ¹⁰	96	108 ¹⁰	96	94 ¹⁰

¹ See page 50 regarding Spain.

² Based on provisional returns.

³ 8076 communes out of 8344.

⁴ 8259 communes out of 8346.

⁵ Exclusive of Alsace-Lorraine.

⁶ Exclusive of Alsace-Lorraine and most of that portion of Possem ceded to Poland.

⁷ Exclusive of Württemberg and the two Mecklenburgs.

⁸ Exclusive of the Saar, Mecklenburg-Strelitz, and the eastern portion of Upper Silesia.

⁹ Descending slopes.

¹⁰ Based on rates.

TABLE 9—Continued

	1918		1919		1920		1921	
	Pre- dicted	Ob- served	Pre- dicted	Ob- served	Pre- dicted	Ob- served	Pre- dicted	Ob- served
Queensland.....	286	273	288	211	289	255	290	285
New Zealand ⁹	266	164	266	226	265	247	264	267
Ireland.....	139	110	139	114	140	150	140	142
Scotland.....	171	126	172	141	172	200	172	186
Fiji.....	128	68	130	104	131	270 ¹⁰	133	245 ¹⁰
St. Lucia.....			170	153 ¹¹	171	184	171	163
Grenada ⁹	188	187 ¹⁰	188	186 ¹⁰	188	189 ¹⁰	188	178 ¹⁰
Trinidad.....			168	123			171	132
Jamaica ⁹	166	103	166	151	166	161	165	123
Barbados ⁹	123	146	122	89	121	112	120	75
Bahamas ⁹					136	159	134	186
British Honduras	177	84 ¹⁰	180	123 ¹⁰	182	180 ¹⁰	184	148
British Guiana..	109	62	109	64	109	124	110	112
Bermudas.....	185	133 ¹⁰	187	144 ¹⁰	188	153 ¹⁰	190	179 ¹⁰
Straits Settle- ments ⁹	63	65	63	91	63	89	63	103
Singapore.....	54	62	54	81			54	87
Dindlings ⁹	68	48	66	76			62	91
Wellesley.....	115	72	116	123			117	124
Malacca ⁹	87	68	86	119			84	137
Penang.....	60	62	60	72			61	101
Gibraltar.....	156	109	157	125	158	131	160	134
British India...	113	57 ¹⁰	113	84 ¹⁰	113	107 ¹⁰		
England and Wales.....	180	108	181	137	181	196	182	185
Austria.....	157	53 ¹²	158	70 ¹²	159	118 ¹²		
Hungary.....					153	145 ¹²		
France ⁹	105	51 ¹³	105	68	105	124	105	117
Belgium.....	161	54	161	114	162	160	162	163
Denmark.....	215	186	217	174	218	196	220	218
Uruguay.....	258	194	260	208	261	207		
Costa Rica.....	173	131	174	139	174	135	175	182
Chile.....	134	134	135	105	136	127	137	117
Bulgaria.....	187	73						
Switzerland.....	173	97	175	131	176	145	177	163

⁹ Descending slopes.¹⁰ Based on rates.¹¹ Based on 9 months return.¹² Disposition of still-births unknown.¹³ Seventy-seven departments only.

be said that, while the number of observations varies from year to year depending upon whether or not data were available, the number of observations for any one year is kept constant for predicted and observed distributions. For this reason, the means for any given year should be considered separately. Finally, it should be remembered that the mean predicted values are predicted on the basis of the trends between the years 1885 and 1913 inclusive. Thus the predicted values are those that would have been expected to result had the same "normal" circumstances prevailed after the year 1913 as before. In other words,

TABLE 10

Showing the means and their probable errors of the frequencies of the predicted and observed vital indices for the years 1918, 1919, 1920, and 1921 for the different countries listed in Table 9, and the differences between the predicted and observed means and their probable errors

YEAR	PREDICTED MEAN	PROBABLE ERROR	OBSERVED MEAN	PROBABLE ERROR	DIFFERENCE	PROBABLE ERROR
1918	169.5	± 5.8	113.2	± 6.4	56.3	± 8.6
1919	168.0	± 4.6	131.2	± 4.2	36.8	± 6.3
1920 ¹	179.9	± 5.5	168.4	± 4.9	11.5	± 7.4
1921 ¹	169.3	± 6.7	165.0	± 5.7	4.3	± 8.8

¹ Excluding the vital indices of Fiji.

we are comparing what should have occurred under normal circumstances with what actually occurred after the forces of war and disease had dealt their disastrous blows. What is the result? Of the countries considered in 1918, the difference between the predicted and observed means is 56.3 ± 8.61 ; of those considered in 1919, 36.8 ± 6.26 ; in 1920, 11.5 ± 7.42 ; and in 1921 the difference is 4.3 ± 8.81 . Thus we see that after two years, on the basis of the probable error of the differences, the predicted and observed means of the countries considered show no significant difference. In other words, in two years the

TABLE 11

Showing the predicted and observed vital indices for the year 1913, and the observed ratios for the years 1920 and 1921

COUNTRY	1913 PREDICTED	1913 OBSERVED	1920 OBSERVED	1921 OBSERVED
Rumania.....	163	162	126	
Finland.....	178	168	162	
Japan.....	169	171	143	156
Spain.....	146	137	126	142
Sweden.....	172	170	177 ¹	173 ¹
Norway.....	195	191	211	
Holland.....	218	229	239	246
Italy.....	161	169	169	174
Bremen.....	188	185	166	185
Prussia.....	194	189	167	
Saxony.....	182	180	192	186
Württemberg.....	182	176	178	170
Hamburg.....	173	170	152	
Lippe.....	216	218	184	186
Germany.....	185	183	171 ²	176 ³
Western Australia.....	275	314	240	224
New South Wales.....	266	264	258	273
Tasmania.....	281	276	282	262
Southern Australia.....	242	269	237	240
Victoria.....	209	232	215	220
Hong Kong.....	17	44	20	30
Mauritius.....	98	110	108	94
Queensland.....	279	291	255	285
New Zealand.....	270	276	247	267
Ireland.....	137	134	150	142
Scotland.....	170	165	200	186
St. Lucia.....	168	185	184	163
Grenada.....	190	204	189	178
Trinidad.....	157	146		132
Jamaica.....	167	163	161	123
Barbados.....	128	150	112	75
Bahamas.....	147	133	159	186
British Honduras.....	165	153	180	148
British Guiana.....	107	143	124	112
Bermudas.....	177	193	153	179

¹ Provisional.

² Exclusive of Württemberg and the two Mecklenburgs.

³ Exclusive of the Saar, Mecklenburg-Strelitz, and the eastern portion of upper Silesia.

TABLE 11—Continued

COUNTRY	1913 PREDICTED	1913 OBSERVED	1920 OBSERVED	1921 OBSERVED
Straits Settlements.....	63	76	89	103
Singapore.....	52	64		87
Dindlings.....	77	84		91
Wellesley.....	111	105		124
Malacca.....	92	84		137
Penang.....	57	75		101
Gibraltar.....	150	149	131	134
British India.....	113	132	107	
England and Wales.....	178	174	196	185
Austria.....	153	146	118	
Hungary.....	149	150	145 ⁴	
France.....	105	106	124	117
Belgium.....	158 ⁵	151 ⁵	160	163
Denmark.....	206	205	196	218
Uruguay.....	252	262	207	
Costa Rica.....	170	189	135	182
Chile.....	129	131	127	117
Switzerland.....	167	162	145	163
Australia.....	247	262	242	252

⁴ Disposition of still-births unknown.⁵ Figures for 1912.

TABLE 12

Showing the means and their probable errors of the predicted and observed vital index frequencies for the year 1913; the means of the observed vital index frequencies for the years 1920 and 1921 and their probable errors and the differences between the means and their probable errors, for the different countries listed in Table 11

YEAR	PREDICTED MEAN	PROB- ABLE ERROR	OBSERVED MEAN	PROB- ABLE ERROR	DIFFERENCE BETWEEN	PROB- ABLE ERROR
1913	(a) 174.2	±5.3	(b) 179.5	±5.3	(a) and (b) 5.3	±7.5
1920			(c) 168.4	±4.9	(a) and (c) 5.8	±7.2
					(b) and (c) 11.1	±7.2
1913	(a) 162.7	±6.2	(b) 168.6	±6.3	(a) and (b) 5.9	±8.9
1921			(c) 165.0	±5.7	(a) and (c) 2.3	±8.5
					(b) and (c) 3.6	±8.5

countries have completely recovered, as far as their natural increases are concerned, from the onslaughts of war and disease.

In Table 11 are listed the predicted and observed indices for the year 1913 and the observed indices for the years 1920 and 1921 for those countries presenting data for the latter years. In Table 12 are presented the means of the columns of Table 11 with their probable errors and the differences between the means, with their probable errors. (The difference between the predicted and observed means for 1913 may well be explained by the widely fluctuating high birth-death ratios of the Australian states for that year.) Here again we find that, when the differences between the predicted and actual values are judged on the basis of probable error, the populations considered returned within two years to their pre-war and pre-influenzal birth-death ratio levels.

Finally, a glance at Table 7 will at least suggest to us that the war and the influenza pandemic had the same insignificant effect upon the vital indices of the United States and Canada. Including the years 1917 to 1922 inclusive, the average birth-death ratio for the United States² is 176.1, while the average of the years 1915 and 1916 is 173.5. In the case of Canada, the average birth-death ratio for 1911 to 1921 inclusive (for four provinces, except for the years 1918 and 1919 when data for only three and two provinces respectively were available) is 200.4, and the average for 1911 to 1913 inclusive is 200.7. On account of the short period of time over which the observations were made, these figures must obviously not be taken as absolute measures. But as indications of the point in question they are certainly significant.

² United States Birth Registration Area.

From the foregoing it may be safely concluded that the phenomenon of natural population growth (natural increase), in its steady, onward march, is susceptible only to a temporary retardation by such catastrophic occurrences as war and destructive pandemic disease.

CHAPTER VII

VARIABILITY OF THE VITAL INDICES

There remain for investigation and analysis the standard deviations of the various countries, tabulated in Table 13. These deviations measure the scatter of the birth-death ratio values about their trends over a period of twenty-nine years. The reader is reminded that they express the amount of variation about the trend and are, therefore, exclusive of the variations bound up in the trends themselves.

What does variation in birth-death ratios mean? When vital indices vary considerably in a given population, what does it signify? We have seen in a previous chapter that vital indices apparently show waves of increase and decrease, due to various influences as suggested; but what produces the fluctuations of the values about these waves? We must again point out that two elements, the birth-rate and the death-rate, enter into a vital index; one or both must be affected in order to alter the ratio. What, then, is likely to change the number of births significantly, from year to year, in a given population? In general, it may be said, nothing. By this we do not deny that certain factors, as outlined in the foregoing section, change the birth-death ratio values. They do. But they produce varying trends and it is for the further variation about the changing trends that we are now trying to account. Variation in the birth-rate does not account for this variation in the vital index values. It is true that the number of births does change from year to year and that there must be some reason for the fluctuation. But fluctuation

TABLE 13

Showing the standard deviations arranged in groups of five units for those countries whose vital index trends were fitted with straight lines

Standard deviations 5-9	Standard deviations 10-14
Reuss (Elder)	(continued)
Mecklenburg-Strelitz	Wellesley
Hong Kong	European Russia
Straits Settlements	Rumania
France	Portugal
Austria	Finland
Hungary	Bremen
Chile	Lubeck
England and Wales	Schamburg-Lippe
Sweden	Schwarzburg-Sonderhausen
Norway	Schwarzburg-Rudolstadt
Italy	Waldeck
Reuss (Younger)	Victoria
Belgium	Russian Empire
Singapore	Prussia
Saxe-Coburg-Gotha	Lippe
Mecklenburg-Schwerin	Saxe-Meiningen
Ireland	Trinidad
Scotland	Oldenburg
Switzerland	
Japan	Standard deviations 15-19
Alsace-Lorraine	Bahamas
Württemberg	Dindlings
Saxe-Altenburg	Mauritius
Saxe-Weimar	Grenada
Baden	Malacca
Bavaria	Servia
German Empire	St. Lucia
Denmark	Australia
Holland	British India
Hesse	Fiji
Penang	Gibraltar
Saxony	Uruguay
Spain	Tasmania
	British Honduras
Standard deviations 10-14	
Anhalt	Standard deviations 20-24
Brunswick	New Zealand
Jamaica	Dutch East Indies

TABLE 13—*Continued*

Standard deviations 20-24	Standard deviations 30-34
Hamburg	Queensland
New South Wales	
British Guiana	Standard deviations 35-39
Costa Rica	Western Australia
Bermudas	
South Australia	Standard deviations 40-44
Standard deviations 25-29	Standard deviations 45-49
Barbados	Guatemala
Bulgaria	

in the birth-rate is not significant. It is produced by a multiplicity of minor factors most of which are incapable of being isolated as contributors. We regard it as a normal variation. Unless a variation differs so much from the "norm" or trend that it cannot reasonably be laid to chance, we do not term it significant.¹ It is believed that, under normal conditions, there should not be a significant variation in the number of births in a given population. This statement, it should be added, is more applicable to large than to small populations, where an increase in the number of births may stand out sufficiently to overcome the effect of calculating the probable error.

The other element of a birth-death ratio, the death-rate, is not quite so unvarying as the birth-rate. But, in a well developed country, whose health conditions are fair, there should be relatively the same insignificant variation from year to year in the number of deaths as in the number of births. There occur, of course,

¹ A deviation is considered probably significant when it is three or more times its probable error, which means that the odds against its occurring from chance alone are 22.24 to 1.

increased deaths from epidemics, which again affect small populations more than large ones. Reference is here made to the sundry, local epidemics of infectious diseases which occur periodically. There are also pandemics of relative infrequency, such as the influenza pandemic of 1918. War and earthquakes are other less frequent factors. But, barring wide-spread epidemics, we find that, under "normal" conditions, the death rate of a given population, with comparatively good health conditions, should not vary to a significant degree from year to year.

Table 13 shows standard deviations in the vital index values varying from 5.2 to 46.9, an apparent contradiction that demands explanation. Assuming that the number of births and deaths in a community are in reality as constant as we have held above, what, beside unstable health conditions and epidemics, can be responsible for such a large variation in the figures? Unless, of course, there are obvious, detectable causes of variation, such as spasmodic migratory disturbances, war, etc., the answer is clear—poor collection of vital statistics.

We have already seen that migratory and associated disturbances have caused most notable fluctuations in the curves of the Australian states. But in a number of the countries dealt with in this study, unsystematic registration of births and deaths is largely responsible for the variations in the vital indices. This is especially likely to be the case in countries where there is a comparatively large extraneous population or a large number of unintelligent natives, as, for instance, in some of the British West Indies and in the Straits Settlements. It must be borne in mind, however, that, while registration or collection may be poor and inadequate, if it is *uniformly* so, it will present but a small standard deviation.

It may then be said that Table 13 presents the countries and states on the basis of the comparative reliability of their statistics. Provided we have some knowledge of conditions in a given country that might be expected to produce variations in its vital statistics, the standard deviation, presented in the table, is a rough evaluation of the correctness of a country's figures on births and deaths. Examining the tabulations, we find the values approximately what we should expect. Those countries whose statistics may be questioned and where general sanitary principles are as yet less carefully applied, as in some of the Latin-American units, have relatively large standard deviations. The reader will recall that the statistics from Guatemala were pointed out as being obtained by an imperfect system of registration. It is interesting to note that this unit possesses the largest standard deviation, 41.8. The Australian states, whose progress over the time span considered has been more or less unsteady (characterized by large fluctuations), present large measures of variation. Western Australia has a very high deviation, 37, due probably in large part to the state's tremendous growth, brought about by the gold discoveries in 1886 and the early 'nineties. The population of Western Australia is increasing at the rate of 3.1 each year.

The older and more settled countries have, on the whole, little variation in their birth-death ratios from year to year. Hamburg presents an exception; her standard deviation is large although her vital statistics are considered reliable. This condition is probably due to Hamburg's situation, in intimate contact with the sea and a portal to Europe. Unless there is the most attentive quarantine service in such a place, infections are likely to be introduced that cause no mean epidemics.

Inland places are less exposed to this type of hazard. Inquiry into the figures for the deaths in Hamburg reveals the fact that they show quite frequent fluctuations of high order, although not all of them are significant. In 1892, however, a cholera epidemic increased the number of deaths by nearly 50 per cent, causing a drop in the birth-death ratio from 156 in 1891 to 90 in 1892. It is noteworthy that a compensatory decrease in deaths occurred the next year, raising the vital index to 180 and, in the next year, to 197. Deviations of this sort have a marked effect on the variation measures of a population's birth-death ratios.

There is one interesting observation to be made in comparing the variability of the different vital index curves: most of the countries considered—where the statistics are not grossly variable—show a common tendency toward greater uniformity, less variability, in their curves, toward the end of the nineteenth century. Large fluctuations become less noticeable and progressively fewer as the years pass by. This phenomenon is probably explained by the advance in and application of preventive medicine and the general principles of public health and by improvement in sanitation. Undoubtedly, it is also partially due, certainly in some places, to an improved reliability of vital statistics. This point should be particularly kept in mind in comparing the countries and states in Table 13.

Summarizing, it may be said that a country's vital index curve is "normally" a uniformly changing trend; if it varies significantly, it is affected by some detectable influence or influences. Any standard deviation of 15 or more, unless explained by conditions known to be productive of a variable birth-death ratio, may arbitrarily be taken as indicative of relatively poor statistics. Also,

it appears, one general effect of public health development has been to stabilize fluctuating death rates, thus decreasing the variability of birth-death ratio trends.

The following pages will be devoted to a general summary of the data that have been presented. The various trends that have been shown to exist will be considered in their relation to the population question. And finally the population question itself will be analyzed and a possible solution suggested for what seem to be the inevitable difficulties consequent upon excess numbers.

CHAPTER VIII

SUMMARY AND CONCLUDING REMARKS

In the present study an effort has been made to present a comparative picture of the biological status of the different populations for which we have vital statistical data. As a measure of the biological status the vital index ($100 B/D$) has been used. This measure was described as showing at any given moment of time the biological soundness of a population in so far as its survival under existent conditions is concerned. That is, the vital index measures the present evolutionary survival value of a population. It does not, however, carry with it any implication as to how that present value has been brought about.

With this meaning of the vital index in mind, let us knit together the various findings that resulted from the inquiry into the relative status of the different populations.

First of all it was shown that virtually all the countries studied possess high mean indices. This fact means one really significant thing: namely, that the races of the world are increasing in numbers and that these races are biologically healthy. It was next noted that some of the populations possess higher mean vital indices than others. These are in the main the northern European races, the Australian states, Canada and the United States. When judged according to their vital indices, regardless of what the various causes may be, these peoples are biologically healthier than are the other peoples. If we were inclined toward speculation, we might say that these peoples are logically destined to become contenders in the race for peopling the earth's

surface. Such a speculation undeniably has sound support. Whether or not the trends will continue in the future as in the past it is impossible to predict; but it is fairly reasonable to assume that this picture of relative biological soundness of the populations will remain essentially unchanged in the years to come, unless some great social alteration the like of which has never yet been experienced, comes about.

From the grouping of the mean values of the vital indices it was noted that there exists a fairly well defined association of a population's survival value with its geographical location. Those countries lying in more or less close proximity to the equatorial latitude were found in general to possess smaller mean indices than those countries lying more distant from the equator. Furthermore, there appeared to be a geographical banding effect of the high and low mean birth-death ratios. To the north, in similar latitudes, are the northern European countries, Newfoundland and Labrador, Canada and the United States. To the south are the Australian states, Cape of Good Hope and Uruguay (and the Falkland Islands, whose figures are, perhaps, not the most reliable). Within broad limits these places both to the north and the south, possess high mean indices, while those places lying in between possess on the whole relatively smaller values.

The relation of these findings to immigration into the United States was discussed.

The countries were next studied from the standpoint of their rates of increase or decrease. It was found again that nearly all of the larger populations possessed high vital indices which in most cases were increasing. Some of the smaller populations showed decreasing indices. Judged on the basis of the magnitudes of the

birth-death ratios and the slopes of increase, the northern European races and the Commonwealth of Australia (and a few of the Latin-American countries) present the soundest biological picture.

The magnitude and slope values of the various geographical groups, which divided the countries roughly on the basis of race and environment, were shown to be negatively correlated. This correlation was explained on the theory that regulatory checks, tending to govern the magnitude and rate of increase of birth-death ratios, operate upon all populations. In the case of larger populations, these checks or influences were held to be biological and economic. Upon smaller populations, it was suggested other minor influences were responsible for the correlation found between the magnitude and the slope values of the vital indices. These minor influences were named as changes in the age distribution of the populations, internal shifting of populations (migratory), droughts, etc. These factors were held to apply chiefly to smaller divisions of a large homogeneous population. It was felt that biological and economic influences on development were less likely to be shown significantly by smaller, subsidiary communities than by larger populations comprising a *group* of countries.

It was pointed out that the action of the above regulatory checks served in no way to insure safety as regards the consequences of excess numbers. It was argued that the evidence of the operation of such checks was exactly the factor that defined and made conspicuous the effects of increasing numbers.

For each of the geographical groups studied was determined what average magnitude would prevail when the slope of zero was reached. These average magnitudes were found to vary considerably. It ap-

peared that the European countries, as a group, have about reached their limit of natural increase under existing conditions. It was noted that some of the individual countries have gone beyond the average magnitude. The Australian and German states were found to be crowding closely their average magnitude. It appeared that the Latin-American units are less near their average, while the Asiatic units show a magnitude of less than 100. (It was pointed out that the figures for the latter units should be considered as only suggestive because of the unreliability of their vital statistics.)

The results of the study up to this point were compared with the findings of other writers in order to bring out more clearly the significance of the vital index as a measure for the status of a population.

An inquiry was next made into the effects of war and disease upon populations, as shown by the vital indices. The insignificance of the effect was demonstrated by comparing the vital indices for the year 1913 with the years following. By taking nine of the belligerent nations and weighting their vital indices for the years 1913 and 1920, it was found that the average birth-death ratios for the two years were identical. A comparison was also made between the predicted and observed indices for the years 1918, 1919, 1920 and 1921. A similar comparison of the predicted and observed vital index values was made for the years 1913, 1919, and 1920. The result of these comparisons, which were made upon all countries possessing data for the years under consideration, was the evidence that the birth-death ratios, although extraordinarily lowered during the war and influenzal years, resumed their pre-war and pre-influenzal levels within two years time. It was therefore concluded that war and pestilence serve only to cause a temporary

disruption in the chief factors of population growth. It was held, furthermore, that population growth was shown to be a steady, uniform and persistent phenomenon.

Lastly, the variability of the vital indices of the various countries was studied. The standard deviations computed from the points on the fitted lines were used for this purpose. It was argued that the number of births and deaths in a given population, with relatively stable health conditions and not subject to marked migratory disturbances, should be insignificantly variable. Upon this basis it was held that any population showing a high variability measure, in the absence of detectable causative factors (such as epidemics, large spasmodic emigrations or immigrations, etc.), was probably collecting its statistics of births and deaths unsystematically or imperfectly. It was noted that a population might have an imperfect system of registration of vital statistics and yet, if the registration system were *uniformly* imperfect, show a low variability measure. The countries were grouped according to their standard deviations. In the main, those countries whose vital statistics might be questioned were found to possess high values, while those countries of longer experience in statistical registration, and whose health conditions are known to be relatively stable, showed low variation measures. The conclusion was drawn that any population showing a standard deviation, computed on the above method, of 15 or more, might be arbitrarily considered, in the absence of obvious or detectable reasons, to possess relatively unreliable figures upon births and deaths.

From this summary we see that there are two outstanding facts with a direct bearing on the population question. They are: (1) Practically all populations are biologically healthy and are increasing in their rates

of natural increase; (2) devitalizing catastrophes such as highly destructive wars and pandemics of great killing force have only the effect of temporarily altering the chief factors of population growth. We may now justifiably ask: What is to be the end result of such growth? Can such increases go on indefinitely?

Opinions on these questions vary, as we have already seen from the views quoted in the earlier chapters. Before entering on the discussion of the population question, itself, we shall quote from a few more sources in order to bring out certain points that make the problem more vivid.

Professor MacDougall (74), quoted in the *New York Times*, seems to think that we are drifting fast toward destruction as a nation. He points out also how Western Civilization applied to the East is making more acute certain aspects of the population problem that are becoming more and more conspicuous.

We remember that the eugenists especially condemned our present social system for allowing the inferior to breed unrestrained and for, indeed, aiding them by various means. Major Darwin (25) writes:

“All who believe in selection as a main agent in evolution, and all who have learnt from Galton how greatly men differ from each other in inborn qualities, will accept it as a fact and not as a mere doubtful hypothesis, that average excessive poverty must be accepted in this country in some degree as a test of the average unfitness of a class, and moreover, that destitution is likely to become a more and more reliable criterion of innate inferiority as time goes on.” The reader will recall from a previous quotation from Darwin (24) that he has concluded that “the tendency of the financial

pressure of poverty to reduce fertility ought not be combated but rather promoted. . . ."

Sterilization of the unfit has been offered as a means of helping to solve the question, especially the qualitative phase of it. The status of the practice of sterilization in the United States is well set forth in Dr. Harry H. Laughlin's book—"Eugenical Sterilization in the United States"—should the reader be interested in this problem.

According to Dean Inge (10): "We could do much to determine our own future; but there has been no consistency about our opinions, and we have frequently followed false lights. What we need is a fixed and absolute standard of values, that we may know what we want to get and where we want to go." Then he asks: "Do we want a nation of beautiful and moderately efficient Greek gods, or do we want human mastiffs for policemen, human greyhounds for postmen, and so on?"

In a very interesting article which appeared recently in the *Eugenics Review* by Austin R. Freeman (75), is outlined the origin and environmental development of the so-called inferior class which he dubs the "subman" or "sub-people." Speaking of the change in the mode of living of man, he says: "The establishment of civilized conditions ushers in a change. Life is now easier. The daily struggle for bare existence has ceased. There begins to be a surplus of the means of subsistence which the more fortunate can share with the less fortunate. And with this easing off of the struggle there has come a softening of manners; a growth of the nobler sentiments of altruism, of charity, or sympathy; of a desire to mitigate the sufferings of the weak and helpless. Religious precept enjoins the prosperous, as a sacred duty, to make up out of their surplus the deficiencies of the less capable.

The defective individual has become an object not only of pity but of care and solicitude. To protect him from the consequences of his own defects has become a pious act which Religion duly acknowledges."

Regarding the result of these changes, Freeman continues: "Looking at these changes broadly from the biological standpoint, it is evident that they represent the growth of conditions ever increasingly favorable to the survival of the unfit; and it is a matter of common observation that such survival has, in fact, occurred. Nor is it possible to doubt that as provisions increase for relieving the incapable of the responsibility for their own maintenance, there will be a corresponding increase in the number of persons demanding such relief."

Finally, speaking of this subject in relation to some of our activities, our author says: "And it is to be observed that the superabundant fertility of the unfit is being reinforced by an ever-increasing inhibition of eliminating agencies. Under natural conditions the defective mental qualities which tend to produce excessive fertility tend also to produce an excessive infant mortality, by which the fertility is to some extent cancelled. But this tendency is countered by the benevolent interference of the fit. The children of the sub-people become the objects of public care and solicitude, with the result that the child-mortality is being steadily reduced. Thus, while the increase is uncontrolled, the elimination is being steadily inhibited. Under these circumstances it is obvious that the proportion of the unfit to the whole population, especially the definitely superior part of it, must be rapidly increasing; and that if these conditions continue to operate, there must presently be established an actual numerical preponderance of the unfit."

The practice of birth control, as is well known, has long been advocated as a means of staving off the world's problem of over-population. Several objections have been raised to birth control. The same objection, for example, that has been made to the practice of sterilization has been applied to birth control, namely that geniuses might be born of parents who theoretically should be sterilized. The celebrated English eugenicist, Major Leonard Darwin (76), already referred to many times, answers, in my opinion adequately, this objection when he says: "No doubt in order to prevent sterilization ever being wrongly applied it would have to be entirely prohibited. No doubt, also, if sterilization had been permitted in the past, Shakespeare's parents might have been rendered infertile, a proceeding which would have resulted in an immeasurable loss for all time. But any child born of parents not both markedly abnormal might prove to be a Shakespeare, and if this argument is valid as regards sterilization it must hold good elsewhere. Granting its validity, all should marry as young as possible and no one should ever limit the size of the family: for otherwise the chance of creating a genius would be missed. This is absurd: for it is obvious that many social conditions as well as the probable qualities of the offspring should always be taken into consideration in regard to the duties of parenthood. We should generally look to probable rather than to possible results."

The reader is referred to the above article of Major Darwin's for a very inspiring defense of eugenics in all its details.

Regarding the many objections raised to the practice of birth control, Colonel Maurice (77) writes: "All the objections to reduction are strong, all should be pondered; but if, as the result of the filling up of the world, a reduc-

tion of the numbers of the peoples of countries that cannot supply their population with food is inevitable, then it is better to bring about the diminution gradually and deliberately, and to try so to arrange that the quality of the less number is raised above the present average, than to delay action till it be too late to avert misery."

These few additional quotations will serve to refresh the reader's mind as to the trend of thought along the question of population increase. Many more opinions might be quoted; and the desire to delve into a discussion of the problem along these lines is difficult for the author to suppress. But this study is not intended to cover such grounds. The writer hopes to touch upon these points in greater detail later on.

Let us turn now to a more specific consideration of the population question. It is no doubt the knowledge of every observer that any change in the mode of living and doing, affecting a mass of people, comes about only slowly and gradually because it is but an evolution of human thought. And with this evolution of thought many subsidiary changes take place affecting the contemplated goal, until, when the goal is realized, it bears only the slightest resemblance to its original form. In so far as individual man is inconsequential, and unable to make but the very slightest impression upon the evolution of life itself. In this sense one is forced to assume a fatalistic philosophy, fatalistic from the individual, not from the collective, standpoint, and simply do that which his reason tells him is right during his own lifetime. Beyond this he can do nothing. Even what he can do may be undone, changed, or carried on, depending upon the reaction of posterity toward his original idea and effort. So in our eternal search for truth, which can at best be but relative truth, we may at least introduce or suggest

those things that to us seem wise. When we do this, we do all that we can, even though it be but little.

There can be no doubt that our mode of living, and all that our mode of living carries with it, has changed. We are proceeding conscientiously along many lines because our traditions, customs and conscience tell us we are right. But history teaches us that even traditions, customs and conscience vary and change. R. A. Fisher (78) has provided us with a very interesting and illuminating study of the evolution of conscience in civilized communities. Everyone is familiar with changes in customs and traditions. The question arises: Have our minds kept the pace; have they realized the changes? Are we not thinking in a lag period? In other words, are we not directing our activities and efforts in the light of accepted truths, customs, habits and trends of three or four or more decades ago?

As James Harvey Robinson (79) says: "A great part of our beliefs about man's nature and the rightness and wrongness of his acts, date from a time when far less was known of the universe and far different were the conditions and problems of life from those of today." Regarding the public unconcern with our newer scientific knowledge, Robinson asks the following question: "Is it safe, since our life has come to be so profoundly affected by and dependent of scientific knowledge, to permit the great mass of mankind and their leaders and teachers to continue to operate on the basis of presuppositions and prejudices which owe their respectability and currency to their great age and uncritical character, and which fail to correspond with real things and actual operations as they are coming to be understood?"

Now with our minds open to the fact that man at best can do but little, and with the realization that all that we

are doing today *may* not be for the ultimate best of civilization, let us analyze the population question.

For the sake of those who may be unacquainted with the mass of literature bearing on the population question, the different prevailing beliefs may be roughly classified into two groups: First, the belief that there undoubtedly is a problem of population so imminent that it behooves us to do something to check its slow but certain oncoming; and, second, the view that there is no such problem; or, better, that there is in theory the possibility of overpopulation but that, for various and sundry reasons, it can never become an actual and pressing problem. It is our impression that the first belief has the greatest number of supporters among those who have written on the subject.

Now just what is meant by over-population? The writer is unable to imagine or define over-population in absolute terms. Since the writings of Malthus, overpopulation has been conceived to mean that overcrowded condition of peoples which is accompanied by insufficient subsistence and consequently by starvation, suffering and great wastage of human life. The overcrowding of a particular area would be commensurate with the virility of the peoples involved and also with the force with which checks on further reproduction and progress of the population might operate.

Let us analyze such a situation. First, it is obvious that the degree of overcrowding must vary, with the area of land, its fertility, the mode of living of the people, etc., in different countries. Second, there can be no doubt that the innate biological constitutions of some races are stronger than others. Thus races would resist at widely different levels and in different degrees the approach of the operation of the natural checks. Finally

it is difficult to believe that one country, or two or three, could reach a state of absolute over-population, in the Malthusian sense, while there existed other countries whose limits had not yet been reached. As one country finds itself in the gradually tightening grip of over-population, it changes its mode of living in order to provide new means of procuring subsistence for its growing numbers. When a country's population grows beyond its agricultural potentialities, it shifts its mode of living to the industrial; it manufactures and exchanges its products for food stuffs, continuing, of course, its agricultural industry. Or a country may purchase territory or acquire it by other methods for the expansion of its population. It is, of course, understood that *all* populations may reach the stage when *all* subsistence has been exhausted. But the writer believes that, because of the different stages of development of different races, and because of the varied reactions of different races to the pressure of excess numbers, relative stages of excess numbers will come first and their results will probably prevent the realization of the final and absolute stage of *world* over-population. It therefore becomes difficult at the present time to conceive of absolute over-population. The writer suggests, therefore, the term *relative over-population* as a bit more accurate and applicable, at least for this day and time.

Now by relative over-population we mean that condition of a population when its numbers are greater than they should be in relation to its potential *agricultural* ability. We rate over-population in accordance with agricultural ability because it is obviously this potentiality, and *not* industrial potentiality, that must in the end be the source of existence. It may be interpreted both as the potential ability of a nation's land to produce

and as the potential ability of a nation's population to produce from its land. In this sense, every nation must of necessity experience relative over-population before absolute over-population can become a reality. It is an early stage and, as will be pointed out subsequently, carries with it serious implications.

From this point of view, some of our larger and aggressive countries are relatively over-populated to-day. Neither Germany nor England can supply adequate food stuffs for their populations from their own lands. Regarding England, Crawford (80) writes: "So far as this country is concerned, it seems to be clear that our dependence on external sources of supply is represented by a volume of food stuffs which could not, under conditions known to our experience, be economically produced in this country." China and India are also relatively over-populated. That is, if there were fewer people in both countries, there would not be the present wastage of human life and human suffering. Wattal (81) in his book on "The Population Problem in India" shows vividly how great is the wastage of life there and how it is brought about by the positive checks of disease and crop failures. He is most earnest in his desire to see the tendency to over-population stopped. We noticed previously that Japan is dangerously close to relative over-population, if not already in its throes. In the United States we are prone to the idea that our resources are unlimited. This belief is far from correct. No less an authority on agricultural limitations in this country that East (82) concludes "that the agricultural possibilities in this country are not so great as they are generally supposed to be, and . . . even if these possibilities were fulfilled wholly the population the country could support is not enormously greater than the figures

Pearl and Reed have set." The population figure set by Pearl and Reed, referred to by East, is 197,274,000 which is less than twice the present population and which will be reached at a time, assuming no unforeseen interference, as Pearl (7) says, when "the great-grandchildren of a number of persons now living will be components of the population." From the figures set forth in the present study, we have seen that virtually all the populations are increasing at rapid rates. Most of the larger nations are now crowding closely the stage of relative over-population. What is going to be the result?

It cannot be denied that, if the present rate of increase continues, and there is no reason to believe that it will not, all nations must gradually become dependent upon outside food sources. At this point the question is invariably raised: What about all the unused or partially used lands throughout the earth? This question is pertinent but its expected answer does not eliminate the inevitable and undesirable consequences of relative over-population. What lands are totally or partially unused? Canada, parts of the United States, Siberia and other portions of Russia, and parts of the tropics. But why are these areas not utilized at present? Because they are not needed. True, but that is not all—because they are less easily utilized, because they are less productive, because they are less desirable for obvious reasons. If they were *choice* lands, would not man have migrated to them and cultivated them as he has other choice lands? And, if they were worked to the limit, what would be the effect in delaying our anticipated troubles? Could they produce enough food stuffs materially to postpone the consequences of excess numbers? In Canada the temperature, lack of rains and configuration of the territories are not the most conducive to habitation and the

pursuit of agriculture. The same is true for Siberia. In the tropical areas we have, beside intermittent periods of drought, unfavorable configurations, etc., the white man's inability to live and reproduce successfully under the tropical climate. As Kohlbrugge (83) has shown: "Until now, no white race has been able to survive in the tropics unless race-mixture takes place."

Thus we see that not without great difficulty and sacrifice can man materially increase the earth's productive area and even then only to a very small extent so far as overcoming the consequences of relative over-population is concerned. Moreover, assuming these partially cultivated areas could produce effectively, it must be remembered that they are not common property. What nation would direct their cultivation? What, indeed, must be the result of the ever-increasing dependence of nations upon foreign resources? Durand (51) puts it well when he says it "is a fertile seed of international discord." Further, he says: "A nation primarily devoted to manufactures and that can maintain its standard of living only by exporting them largely in exchange for food and materials naturally seeks to secure to itself exclusive sources of supply or, in the more common phrase, exclusive markets for its products. It looks with jealousy and fear upon the growth of the trade of another industrial nation with such sources of supply.

"Pressure of population in a crowded nation results in constant and strenuous efforts to control markets. It is all but inevitable that this industrial and commercial struggle should ultimately lead to war."

Similarly, the European writer, Wicksell (84) claims that whatever else may be regarded as a cause of war—ambitions of rulers, militarism or capitalism—the principal factor is always the pressure of population.

Thus we come to what in the writer's mind are inevitable consequences of relative over-population—international conflicts. From the nature of the case, so long as populations continue to grow and grow, there will be ever recurrent consequences until, some day, some one nation will perhaps people the earth. Carr Saunders (9) holds that war is not a result of over-population but a "custom." It is true that, long before excess numbers were ever thought of, we had wars on top of wars. But this does not in the least explain our wars of today. Can it be denied that most, if not all, of a nation's so-called diplomacy in dickering for this and that is but fundamentally and ultimately in order to protect its people from possible future restrictions of one kind or another? And are not all such moves prompted, perhaps not always consciously, by the gradual, persistent, impelling force of increasing numbers? It is but a natural thing, the same thing a paternal parent does when he goes about securing his increasing family against possible future deprivations. The latest international contention over oil lands in the East is but a current example of this effort to protect and insure. And it is interestingly suggestive to note in passing that our country has become involved. The writer realizes that it would, of course, be absurd to hold that all wars are a result of relative over-population. We do hold, however, that, if our present trends continue, more international conflicts are sooner or later unavoidable.

H. G. Wells (85) believes that birth control is a *sine qua non* of world peace as well as of rendering the earth a decent place to live in. He cautions the old civilization that "we cannot go on giving you health, freedom, enlargement, limitless wealth, if all our gifts to you are to be swamped by an indiscriminate torrent of

progeny. We want fewer and better children who can be reared up to their full possibilities in unencumbered homes and we cannot make the social life and the world peace we are determined to make, with the ill-bred, ill-trained swarms of inferior citizens that you inflict upon us."

Leaving for the moment the question of war let us consider the state of affairs when the asymptotic levels of populations—the upper limits of population growth in a given area under known conditions—have been reached. About this level the numbers would fluctuate, controlled by the natural checks concomitant with the situation, such checks as disease, starvation and general wastage of human life. This, then, would be absolute over-population, with Nature alone taking the situation in hand in ways by no means pleasant. It is problematical how long such a condition could prevail; many interesting speculations are possible. Man might attempt to control conditions by means that would seem drastic to us at the present time but that were practiced by the human race at earlier stages of civilization,—infanticide, abortion and the like. Failing in this and with the standard of living constantly falling, it is probable that man would begin a marked evolution and become re-adapted to his new conditions. With the passing of many centuries, even thousands of years, we should find man not the admirable physical type of today but a peculiar organism, characterized, probably, by an exaggerated disproportion between brain and body, the latter insignificantly small.

On the other hand, there are those who believe that when man reaches this stage, or even earlier, when it is only threatening, he will, through his keenness of intellect, so alter conditions that the pressure of numbers will not be felt. It is easy to say that man will learn to synthesize food-stuffs and thereby be independent of natural re-

sources; that he will take heat directly from the sun for all his purposes and so on. We do not deny the possibilities of these and similar accomplishments—we have that much faith in man's ability—but it would seem a bit safer to synthesize a few food stuffs first and be sure that they would take the place of our natural foods before we go blindly ahead in the conviction that all these matters *can* be easily taken care of.

To believe, however, that populations will actually grow beyond the stage of relative over-population seems to the writer to be presupposing that man's thought processes and reason will never dominate his emotions and instincts. We are inclined to be more optimistic. In spite of the conviction that the underlying motive for encouraging population growth is the protection of peoples and land,—which is but another way of saying for militaristic purposes,—optimism is made possible by the lack of disproportion between national powers. That is, if the contending nations today were less evenly matched in strength (meaning geographic advantages, numbers, wealth and ingenuity), there could be little hope that ambitions, emotions and instincts might ever be conquered by reason. We believe that, before any one nation can take possession of the earth, there will be innumerable struggles that *may* convince man of the problems surrounding him. Just how long these consequences of relative over-population must be felt no one can say. Man's mind must evolve further in order to comprehend fully current and inevitable future conditions. When that evolution takes place (and it is perhaps only our personal propensity toward optimism that makes us believe that it will, some day, before any one nation can become supreme), then, perhaps, there will be an honest endeavor to put an end to human suffering.

Nations may become tired of struggling by realizing the futility of it and become content with their lots. Otherwise, so long as numbers increase, there can not be peace until one nation shall have become all-powerful. It may be that, even were nations to become content with their lots, peace would be short-lived. The old desire for power would then arise in one or more nations and the struggle would continue as before.

It is our belief that there is only one way that nations can avoid the consequences of relative over-population. That is by an international agreement to control numbers—by a *league of stationary populations*. Will it ever become a reality? No one can deny that it is possible. We say to parents: “Your children must not work” and “your children must go to school.” Would it be inconceivably absurd to say to them: “You are at liberty to rear only three or four children” (depending upon the size of the population, mortality forces, etc.)?

We are not alone in the belief in this solution. Mr. Cox (31) in his book, “The Problem of Population,” suggests that the best guarantee of future peace would be a “League of low birth-rate” amongst European nations. It seems to us, indeed, that the points we have here brought out might well engage the attention of those individuals who are endowed with the spirit of the reformer and who are opposed to war. There is, we feel, a great deal of honest effort lost in that it is diverted toward matters of relatively superficial importance. The same may be said of many of our organizations—that they fail to face the important and fundamental fact of population trends. We feel that it would be an excellent thing if both individual reformers and associations would acquaint themselves with the facts and work in the light of them. What we are capable of doing may be little,

but we can do at least that much. It is impossible to predict whether or not all nations would keep faith with such a league as we have proposed. Perhaps some would not; but it is at least not an altogether impossible solution and one that is potentially capable of averting international strife.

It seems to the writer that a league of "stationary populations" would involve less discrimination among nations and hence be more possible of realization than the league of "low birth-rate" suggested by Mr. Cox. Either solution, if internationally accepted, would give the desired result but difficulty might easily arise in ascribing different birth-rates to different nations. The fact of differential racial fertility enters here into the calculation. A low birth-rate is a relative term whereas a stationary population avoids the issue of discrimination in the strictest sense.

The qualitative aspect of the population question within any nation cannot so lightly be disposed of. There appears to be a well-defined differential fertility between classes of the population. As we have already said, man's inability to agree on criteria of good and bad, fit and unfit, desirable or undesirable, except in the grossest sense, makes human selection of the desirable element difficult, if not, for the present, at least, impossible. What we can do now is necessarily crude and general in its application. One can only hope that the public mind, after becoming familiar with crude and general methods, may progress to a toleration of finer and more specific methods.

The program of stationary populations could, however, have but little effect upon the qualitative aspect of the population question. True, whether the so-called upper classes produced their quota of children or not, the lower

classes would be curbed in their now high fertility. But, if differential fertility persisted,—and indications are that it would—sooner or later the lower class element would be numerically the stronger just the same.

The relation of this differential fertility among classes to the rise and fall of civilizations in the past is an interesting one. Carr Saunders (9) has pointed out: "Generally speaking, throughout the Middle Ages, so far as it is known, the so-called upper classes contributed less to the population than the so-called lower classes. The position is now reversed, and it would appear that in the later days of Greece and Rome also the upper classes contributed less to the population than the lower classes. It is possible that the same may have been the case in other ancient empires." There have been various explanations offered for this broad rise and fall of reproductive vigor on the part of classes. There are several adherents of the Spencerian view that there is a natural and inevitable connection of a physiological nature between an advancing civilization and a decreasing birth-rate; that there is an overdraft on the nervous mechanism which becomes detrimental to the normal functioning of the reproductive mechanism. Many others believe that the restriction of size of family by the upper strata of society is a purely voluntary and selfish act, and so on.

Whatever the cause may be, the phenomenon seems to be so firmly established as to approach the importance of a natural law. MacDougall (86) writes: "Looking at the course of history widely, we may see in the differentiation of the social classes by the social ladder and in the tendency of the upper strata to fail to reproduce themselves, an explanation of the cyclic course of civilization." Carr Saunders (9) disagrees with this view, saying: "There are grounds for thinking that those who see in

differential fertility the cause of the cyclical course of civilization both overestimate the results and neglect certain aspects of the changes involved. Differential fertility is not a factor to be disregarded; the results which it is now producing demand the most careful investigation. Nevertheless, so far as our knowledge extends, we should view it rather as the result than as the cause of the cyclical course of history—the course which historical changes take being due primarily to changes of tradition.”

Regardless of the correctness of either of these views, it appears certain that differential fertility is a concomitant of the broad, cyclical developments of nations. What can we do to affect it? Man can conceivably restrict man's fertility but it is extremely difficult to conceive of man compelling man to reproduce, especially in those classes where increased fertility is desired. It is the writer's opinion that we can no more stabilize the cycles of differential fertility than we can stabilize the interrelated movements of the planets. We may, perhaps, momentarily retard or accelerate them, increase or decrease the waves to a slight degree, but we cannot affect their wave-like movements so long as human reproduction continues. Just as there is variation in nature, so is there variation in man. And variation of accomplishments means the *natural* formation of social strata commensurate with accomplishments. In general, we may say that man's tendencies are more toward progress than toward regress. It may be true that, in order to prevent retrogression, the so-called upper classes in any civilization are inspired by a complex of economic factors to use contraceptives. And it may be that the result is a clear, differential fertility that may or may not be a concomitant of decline in civilization. Whatever the

cause or result, the phenomenon of differential fertility appears as a fundamental biological fact inherent in the evolution of man; and its cycles, therefore, are capable only of modification, not of stabilization, by human effort.

There is no hope in the writer's mind that what has been said will make the slightest impression upon things as they now are. All that is hoped is that perhaps a few minds, heretofore closed to the consideration of the matters we have brought up, may be slightly opened and that later discussions of the population question may experience somewhat less resistance. It is only thus gradually that new ideas take hold of the thinking population. If our views should be proved wrong, they have at least served a purpose. It is possible that our views are quite erroneous and that the state of affairs today is exactly what it should be. In that case, too, we should not have expressed ourselves in vain, for we should all then be clear on a matter that is now open to question.

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APPENDIX

TABLE I
Vital indices of various countries by years

YEAR	HONG KONG	SINGA- PORE	PENANG	DIND- LINGS	WELLES- LEY	MALACCA	STRAITS SETTLE- MENTS	FIJI
1881	39							
1882								
1883	31							
1884	36							
1885	30							
1886	30							83
1887	32							112
1888	28	47	52	133	85	116	68	114
1889	37	47	52	133	85	116	68	89
1890	36	43	47	82	103	73	60	
1891	32	47	46	108	92	102	64	73
1892	38	59	56	132	98	130	79	78
1893	33	49	55	116	118	107	73	81
1894	20	54	52	115	98	119	74	86
1895	26	40	47	114	102	94	62	
1896	21	34	42	89	73	93	52	82
1897	29	42	39	125	85	87	56	92
1898	21	49	50	119	109	121	71	86
1899	18	51	53	117	124	128	76	100
1900	14	44	42	90	108	130	66	89
1901	15	42	47	113	105	116	64	87
1902	18	40	41	73	106	114	58	98
1903	17	44	50	99	116	119	67	64
1904	20	50	45	123	111	104	46	92
1905	20	52	48	109	107	118	70	114
1906	16	56	40	98	103	100	67	113
1907	20	56	48	62	120	112	67	112
1908	15	48	51	74	119	96	67	120
1909	19							130
1910	20	52	59	99	87	86	65	105
1911	23	42	57	54	95	55	54	111
1912	28	54	76	80	121	78	72	145
1913	44	64	75	84	105	84	76	156
1914	31	78	71	80	117	92	85	152
1915	33	96	91	108	124	102	101	172
1916	25	86	90	59	118	88	91	183
1917	23	74	82	80	115	82	83	173
1918	17	62	62	48	72	68	65	68
1919	19	81	72	76	123	119	91	104
1920	20						89	270*
1921	30	87	101	91	124	137	103	245*

* Based on rates.

TABLE I—Continued

YEAR	SPAIN	HUN- GARY	CHILE	BRITISH INDIA*	CEY- LON*	MAURI- TIUS†	BRITISH GUIANA	TRINI- DAD	VENE- ZUELA
1864	124								
1865	114								
1866	132	108							
1867	127	116							
1868	106	126							
1869	109	134							
1870	117	128							
1871		110							
1872		97							
1873		65							
1874		100							
1875		122							
1876		130							
1877		119							
1878		114							
1879		128							
1880		115	122						
1881		125	162						
1882	113	124							
1883		136	147						
1884	117	144							
1885		137	93	124					
1886		141	109		115				
1887		131		124	133	108			
1888		137		125	120	117	105	117	
1889		147		107		109	128	117	
1890		125		108	138	104		119	
1891		128	89	113		139	73		
1892		110	104	99	110	104	70	135	
1893		137		130	106	62		126	
1894		136	120	108	119	131		136	
1895		140	120	115		100	74	137	
1896	121	140	118	108		73	124	127	
1897	120	141	123	84	159	120		112	
1898	118	135	125	120	146	114	88	118	
1899	119	144	124	139		98		146	
1900	117	146	104	63	156‡	106		146	

* Based on rates.

† Average rates for General and Indian population.

‡ Apportioned from mean annual rates on five year groups.

TABLE 1—Continued

YEAR	SPAIN	HUN- GARY	CHILE	BRITISH INDIA*	CEY- LON*	MAURI- TIUS†	BRITISH GUIANA	TRINI- DAD	VENE- ZUELA
1901	126	149	105	102		86	152	138	
1902	136	144	131	121	124‡	106		149	
1903	146	141	125	100		90	100	140	
1904	134	149	126	119	139‡	117	105	174	
1905	136	128	109	113	141‡	91	123	140	118
1906	130	145	112	107			114	137	130
1907	137	143	131	99	109	100	76	129	142
1908	143	146	124	104	70	90	88	146	124
1909	139	147	124	118	121	94	96	152	136
1910	142	151	123	119	141	108	80	155	149
1911	135	140	124	121		119	91	148	151
1912	150	156	130	122	103	89	113	114	116
1913	137	150	131	132	136	110	143	146	145
1914	135	148	136	130	118	125	140	142	147
1915	136	93	141	126	147	102	113	148§	119
1916	134	80	144	128	146	116	98	158	113
1917	129	77	139	120	162	112	94	157	134
1918	88		134	57	123		62	131	112
1919	121		105	84	96¶	53	64	123	134
1920	126	145	127	107	123¶	108	124	123	136
1921	142		117		131¶	94	112	132	121

YEAR	AUS- TRIA	GREECE	RUMA- NIA	GER- MANY	BEL- GIUM	DEN- MARK	PORTU- GAL	ITALY	JAPAN	NOR- WAY
1870	134	128								
1871	129	141	127							
1872	119	139	105							
1873	102	114	100	140	148	165	128	121		
1874	128	151	98	150	155	155	130	115		
1875	136	144	121	147	143	152	144	123		
1876	138	152	130	155	152	165		136		
1877	126	148	118	152	153	170		131	144	188
1878	125	147	100	256	147	171		124	145	197
1879	135	137	130	149	144	162		127	122	213
1880	126	136	105	142	139	156		110	146	193
1881	123	130	156	146	150	176		138	137	180
1882	127	134	144	145	154	166		135	138	168
1883	127		166	142	146	169		135	149	181

* Based on rates.

† Average rates for General and Indian population.

‡ Apportioned from mean annual rates on five year groups.

§ Based on nine months returns.

¶ Based on actual figures.

TABLE I—Continued

YEAR	AUS- TRIA	GREECE	RUMA- NIA	GER- MANY	BEL- GIUM	DEN- MARK	PORTU- GAL	ITALY	JAPAN	NOR- WAY
1884	132	162	164	143	146	178		145	138	189
1885	125		172	144	149	178		143	116	190
1886	129		158	142	140	175	157	129	112	192
1887	132		137	152	152	174	153	139	140	192
1888	130		139	154	147	161	153	136	156	182
1889	145	140	150	154	148	168	150	150	152	170
1890	125	140	136	147	140	160	129	136	141	169
1891	137		141	158	141	155	140	142	129	177
1892	126		113	148	133	152	154	138	137	166
1893	140		131	150	146	162	149	145	126	188
1894	132		128	161	154	173	143	142	144	176
1895	138		152	163	146	174	144	139	146	196
1896	144		140	174	166	190	131	144	140	200
1897	146		145	169	168	175	139	158	152	196
1898	145		138	176	162	190	141	146	153	198
1899	146		152	167	153	168	148	155	148	183
1900	147		161	161	150	172	150	139	155	189
1901	152		150	173	172	184	150	148	161	199
1902	150		141	180	164	195	162	150	157	209
1903	148		162	169	162	191	164	142	176	194
1904	150		164	174	160	200	167	155	159	197
1905	135		155	166	158	185	159	148	153	186
1906	155		167	182	157	206	146	154	146	196
1907	150		156	179	160	194	156	152	158	185
1908	148		147	178	151	190	152	148	161	183
1909	146		150	181	150	213	159	151	155	194
1910	153		158	184	156	214	165	168	161	193
1911	143		167	165	140	199	176	147	167	196
1912	152		190	182	151	205	174	178	168	190
1913	146		162	183		205	160	169	171	191
1914	141		179	173		204	164	173	164	188
1915			165	136		189	160	150	165	179
1916				107	97	182	149	122	152	192
1917				86	69	179	141	101*	152	190
1918	53		35	58	54	186	72	56	120	146
1919	70		109	129	114	174	109	112	139	164
1910	118		126	170	160	196		169	143	211
1921				176	163	218		174	156	

* Including 30,000 killed in earthquake.

TABLE I—Continued

YEAR	ALGERIA	SAXONY	MECK- LENBURG- STRELITZ	BAVARIA	ALSACE LOR- RAINE	BRITISH HON- DURAS	BARBA- DOS	GIBRAL- TAR*	CAPE OF GOOD HOPE
1880	118								
1881		141	156	134	124				
1882	119	139	141	132	125				
1883		134	130	127	125				
1884	119	133	133	133	133				
1885		139	144	130					
1886		135		130	128				
1887		147	139	129	137	103			
1888		152	153	128	123		202		
1889		150	153	135	131		118	135	
1890		142	149	128	123		148	109	
1891		155	150	134	137	110	114	121	
1892		150		132	131		188	135	
1893		149	145	135	128	93	162	161	
1894		161	152	141	128	96	118	123	
1895		161	160	143	142	132	162	132	146
1896		178	170	158	154	147	142	146	153
1897	166	166	150	150	151	139	145	118	152
1898	138	169	171	154	138	128	96	110	131
1899	146	159	135	152	153	128	142	117	144
1900	114	168		145	142	166	157	116	112
1901	114	174	142	161	157	139*	122	145	130
1902	156	185	161	163	157	139	118	106	131
1903		171	134	152	148	145	189	144	138
1904	114	171	143	159	150	156	161	144	140
1905	122	162	135	153	145	105	137	144	144
1906		171	159	163	153	110	97	142	162
1907	131	176	148	161	154	165	124	156	170
1908	150	175	139	162	148	158	126	148	178
1909	129	180	154	161	142	170	149	183	165
1910	140	180	137	165	164	159	157	140	160
1911	142	158	139	154	139	171	134	152	171
1912	169	180	147	169	158	163	90	133	170
1913		180	147	167	152	153	150	149	149
1914		132		142		150	103	174	174
1915		96				153	155	124	156
1916		66				148	141	117	142
1917		53				129	116	119	135
1918		48				84	146	109	64
1919		122				123	89	125	102
1920		192				180	112	131	121
1921		186				148	75	134	130

* Based on rates from 1901 following.

TABLE I—Continued

YEAR	DUTCH EAST INDIES	DUTCH WEST INDIES	WURTEM- BERG	MECK- LENBURG- SCHWER- IN	HAM- BURG	BADEN	PRUSSIA	RUS- SIAN EM- PIRE*	BER- MUDAS
1881	102		141	163	146	144	146		
1882	117		141	153	147	144	148		
1883	117		143	134	137	147	145		
1884	155		138	146	134	145	146		
1885	135		135				148	151	
1886	146		143	138	114	139	145		
1887	187		153	140	122	149	158		
1888	142		138	155	128	134	164		150
1889	138		131	151	154	139	160	143	162
1890	154		136	148	166	135	152		136
1891	132		140	148	156	143	165		150
1892	162		134	147	90	146	155	113	155
1893	161		131	148	180	134	155		72
1894	192		136	160	197	137	168		
1895	130		147	162	180	151	169	146	150
1896	125		165	168	199	165	178	150	140
1897	101		151	163	180	158	175	158	149
1898	141		158	184	175	157	183	150	162
1899	143		163	154	166	166	170	159	145
1900	135		147	144	159	153	166	160	161
1901	108		163	155	156	165	177	153	156
1902	108		169	166	161	172	185		150
1903	140		163	152	158	164	174		154
1904	166		164	160	168	166	242	162	186†
1905	160		160	150	156	165	171		185
1906	147		171	164	162	172	188		160
1907	175		172		172	173	185		185
1908	168		170	148	170	178	183		
1909	179		172	165	169	172	187		165
1910	149		173	162	166	177	191		
1911	164	126	160	144	150	165	171		142
1912	166	113	182	145	162	178	186		
1913	178	128	176	155	170	174	189		193
1914	177	173					152		195
1915	191	190					96		194
1916	219	179					84		172
1917	208	157	94				71		170
1918	154	121	82		62		60		133
1919	187	90	140		110		128		144
1920		155	178		152		167		153
1921		138	170						179

* Exclusive of Finland.

† Based on rates.

TABLE I—*Continued*

YEAR	WALDECK	BRUNS- WICK	REUSS, YOUNGER	SAXE WEIMER	SAXE- ALTEN- BURG	FIN- LAND	ST. LUCIA	JAMAI- CA	BUL- GARIA
1881	144	144	155	146	144				
1882	160	135	151	141	144				
1883	138	138	146	130	130	169			
1884	167	150	137	141	132	169			
1885	165					153			
1886	154	146	141	140	132	156			
1887		171				186			
1888	179		157	148	141	169	152	175	
1889	147	156	160	155	162	170	159	159	
1890	134	146	161	142	152	168	149	153	166
1891	169	180	184	166	170	164	161	168	146
1892	153	161	146	152	154	133	152	178	114
1893	171	164	150	148	146	143		184	127
1894	160	165	166	162	156	160	197	177	138
1895	177	165	160	160	161	180	168	171	153
1896	185	197	174	166	174	170	165	174	170
1897	164	188	158		157	182	157	173	166
1898	186	191	171	170	173	195	153		170
1899	159	175	170		164	167	157	185	165
1900	161	172	162	171	164	149	184		189
1901	157	170	171	176	163	158	139	187	163
1902	177	184	178	174	178	171	147	199	164
1903	157	162	169	161	161	170	195		181
1904	170	169	163	170	165	180	170	146	200
1905	162	159	152	148	156	166	155	177	200
1906	183	167	162	176	179	180	160	145	197
1907		168		175		174	143		194
1908	173	162	170	173	173	167	139	168	166
1909	158	163	173	182	186	188	177	174	152
1910	174	168	172	176	176	182	173	166	180
1911	167	140	157	159	158	177	168	178	187
1912	183	160	177	178	187	179	171	155	202
1913	185	160	178	180	179	168	185	163	90
1914						173	171	182	219
1915						160	164	160	202
1916						146	160	148	102
1917						138	164	126	79
1918						84		103	73
1919						102	153*	151	
1920						162	184	161	
1921							163	123	

* Based on nine months returns.

TABLE I—Continued

YEAR	SAXE MEIN- INGEN	AN- HALT	BREM- EN	LU- BECK	REUSS, ELDER	SAXE COBURG GOTHA	HESSE	SERVIA	COSTA RICA	BA- HAMAS
1881	149	163	162	150	157	156	146			
1882	143	175	162	146	165	145	145			
1883	143	149	156	146	144	125	144	206		
1884	140	155	154	147	146	145		190	241	
1885			150	168		149	138	173		
1886	154	147			165		149	142	172	
1887		186	149	143			145	186		
1888	152	188	151		169	149	137	188	180	154
1889	171	171	156	166	192	161	150	173	175	212
1890	163	170	166	156	174	158	134	151		210
1891	179	181	164	155	195	168		169	90	181
1892	150	165	169	172	162	160	142	127		154
1893	153	172	179	159	161	155	139	143	175	164
1894			194	181	174	173	158	151		178
1895	164	177	180	181	179	169		164		170
1896	175	194	186	201	185	181	172	153		153
1897	173	185		172	168	174	171	161	198*	182
1898	185	175	188	200	182	179	173	153	164	177
1899	172	176	191	158	170	172	180	162	140	166
1900		170	180	171	166	170	171	180	170	164
1901	193	181	173	179	180	177		181	148	164
1902	202	199	184	195	170	189	182	171	139	
1903	185	171	179	190	159	179	178	174	159	179
1904	198	145	178	188	170	178	183	189	170	
1905	179	160	174	175	152	164	178	154	137	188
1906	209	182	186	184	180	174	188	172	160	177
1907	197		184	178				175	167	136
1908	186	167	183	176	161	177	191	155	168	139
1909	198	178	193	180	171	173	189	132	170	185
1910	182	174	182	173	169	179	193	174	163	146
1911	179	133	173	154	153	157	179	167	178	157
1912	180	164	168	161	167	185	183	180	189	122
1913	189	166	185	163	159	188	192		189	133
1914									196	142
1915			100						196	215
1916									179	227
1917									185	189
1918									131	
1919			125						139	
1920			166						135	159
1921			185						182	186

* Beginning of "Official Registration."

TABLE I—Continued

YEAR	LIPPE	SCHAUMBURG LIPPE	OLDENBURG	SCHWARZBURG RUDOLSTADT	SCHWARZBURG SONDERHAUSEN	GUATEMALA	GREENLAND	ISLAND SAMOS	NEWFOUNDLAND LABRADOR*	ARGENTINE REPUBLIC
1881	169	149	146	160	160					
1882	174	160	153	159	161	177				
1883	164	158	151	145	160	102				
1884	152	159	158	144	134	112				
1885	168	191				247				
1886			153	166	161	244				
1887	173	198	159			255				
1888		176	170	158	154	221	195	193		
1889	197	203	165	181	173	216	185	243		
1890	161	173	169	164	166	88	180	232		
1891	196		150	194	192	137	180	227	150	
1892	182	170	164	164	155	249	206	200		
1893	166	156	160	157	153	240	177	187		
1894	185	181	163	185	179	223	207			
1895	210	196	179	168	175		216			
1896	197	218	197		184	202	207	201		
1897	195	190	184	185	175	163	167†	238		
1898	232	198	211	195	163		202†	233	188	
1899	199	188		180	162	208	228†	229	165	224
1900	205	206	177	193	176		216†	202	188	196
1901	209	191		177	174		192†	217	188	
1902	202	192	215	198	196		200†		183	
1903	207	184	200	178	183		166†	242		214
1904	195	195	204	191	179		205†		183	232
1905	200	215	200	174	179		181†	191		219
1906	217	193	214	192	191		145†		147	197
1907	201						185†		168	200
1908	207	206	211	175	190		185†			196
1909	207	193	226	210	195		182†		195	194
1910	209	209	221	187	178	212	174†			205
1911	194	180	209	171	167	207	204†		178	209
1912	216	188	227	180	196	170	204†		185	226

* Based on rates.

† Based on rates. (The yearly sequence of these ratios is not clearly stated. They have been listed thus on the basis of appearing in successive volumes of the Statesman's Year Book.)

TABLE I—Continued

YEAR	LIPPE	SCHAUMBURG LIPPE	OLDENBURG	SCHWARZBURG RUDOLSTADT	SCHWARZBURG SONDERHAUSEN	GUATEMALA	GREENLAND	ISLAND SAMOS	NEWFOUNDLAND LABRADOR*	ARGENTINE REPUBLIC
1913	218	200	244	187	189	197	204†			234
1914							204†		194	234
1915						187	138		213	228
1916							203		146	210
1917							174		151	212
1918	58						187			185
1919							186			183
1920	184						189			214
1921	186						178		208	

YEAR	QUEENS- LAND	NEW ZEALAND	SWITZER- LAND	SOUTH AUS- TRALIA	TAS- MANIA	WEST- ERN AUS- TRALIA	URA- GUAY	AUS- TRALIA	FALK- LAND IS- LANDS*
1869	397								
1870	298								
1871									
1872	272								
1873		308	129						
1874	225	309	134						
1875		253	130						
1876		330	134						
1877		360	135						
1878	175	383	133						
1879	245	324	135						
1880	272	356	135						
1881	248	341	133	267					
1882	199	333	132	247	212	253	225		
1883	196	317	140	252	200	189	256	228	
1884	156	346	140	247	230	153	219	216	
1885	187	324	130	302	228	182	231	222	
1886	226	315	134	264	234		219		
1887	262	312	138	275	219	222	204	244	
1888	258	231	139	280	235	237	223	244	
1889	235	320	136	295	227	261	218	225	
1890	273	305	127	264	227	289	193	244	
1891	285	280	137	255	222	206	231	232	

* Based on rates.

† See note on preceding table.

TABLE I—Continued

YEAR	QUEENS- LAND	NEW ZEALAND	SWITZER- LAND	SOUTH AUS- TRALIA	TAS- MANIA	WEST- ERN AUS- TRALIA	URA- GUAY	AUS- TRALIA	FALK- LAND IS- LANDS*
1892	283	277	145	284	240	198	222	261	
1893	253	269	139	236	252	224	206	239	
1894	264	268	136	262	250	196	199	244	
1895	289	270	142	269	264	148	236	244	
1896	248	289	158	248	242	138	243	224	
1897	264	284	151	240	239	152	221	233	240
1898	223	262	147	191	194	183	233	192	
1899	226	245	155	213	211	223	268	212	227
1900	258	272	141	242	256	244	238	232	
1901	238	268	152	228	272	227	254	223	375
1902	229	247	167	211	266	221	255	214	302
1903	199	256	157	219	241	240	259	208	456
1904	268	282	159	245	268	274	252	240	256
1905	248	294	153	235	285	280	268	241	534
1906	275	291	162	230	265	253	234	244	330
1907	260	249	160	246	265	264	234	244	252
1908	370	287	167	254	264	269	270	250	486
1909	281	296	158	266	299	281	234	258	269
1910	282	269	165	263	263	276	218	256	282
1911	260	276	153	274	282	277	227	256	280
1912	271	298	170	279	284	260	234	256	140
1913	291	276	162	269	276	314	262	262	214
1914	295	279	164	274	314	302	251	267	171
1915	267	280	147	251	290	301	229	256	165
1916	252	269	146	234	274	277	182	243	227
1917	302	268	135	260	304	285	212	271	384
1918	273	164	97	259	293	251	194	250	632
1919	211	226	131	202	242	193	208	185	248
1920	255	247	145	237	282	240	207	242	226
1921	285	267	163	240	262	224		252	

YEAR	ENGLAND AND WALES	HOLLAND	SCOT- LAND	FRANCE	VICTORIA	IRELAND	NEW SOUTH WALES	EURO- PEAN RUSSIA†
1839	145							
1840	140							
1841	149							
1842	148							
1843	152							

* Based on rates.

† Exclusive of Finland, Poland and Bessarabia.

TABLE I—Continued

YEAR	ENGLAND AND WALES	HOLLAND	SCOT- LAND	FRANCE	VICTORIA	IRELAND	NEW SOUTH WALES	EURO- PEAN RUSSIA *
1844	152							
1845	156							
1846	147							
1847	128							
1848	141							
1849	131							
1850	161							
1851	156	157						
1852	153							
1853	145							
1854	145			93				
1855	149			96				
1856	168			114				
1857	158			110				
1858	146	141		111				
1859	156			104				
1860	162	140	155	122				
1861	160		172	116				
1862	163		160	122				
1863	154		153	120				
1864	149		151	117	289	146		
1865	152	144	160	109	248	155	262	
1866	151		159	114	204	156	230	
1867	163		165	116		154	212	144
1868	164		167	107		168	256	123
1869	156		150	110		162	288	130
1870	154		156	90		166	300	140
1871	155		156	68		171	314	133
1872	168		157	122		153	269	121
1873	168	150	156	112		148		143
1874	162	160	153	122		154		146
1875	157	143	151	112		141		149
1876	174	155	171	116		152		145
1877	178	165	172	118		149		144
1878	165	157	165	112	209	135		124
1879	167	163	172	112	221	129		134
1880	167	151	164	107	224	124		137
1881	180	163	175	113	204	140		137
1882	172	170	173	112	196	139		129
1883	170	157	162	112	212	123	255	135
1884	171	157	172	109	214	136	239	
1885	171	164	169	110	209	128	229	150

* Exclusive of Finland, Poland and Bessarabia.

TABLE I—Continued

YEAR	ENGLAND AND WALES	HOLLAND	SCOT- LAND	FRANCE	VICTORIA	IRELAND	NEW SOUTH WALES	EURO- PEAN RUSSIA*
1886	168	158	174	106	206	130	180	
1887	167	171	167	107	206	127	277	144
1888	172	166	173	105	212	128	267	155
1889	171	165	168	111	188	130	252	143†
1890	155	160	154	96	209	123	274	137†
1891	156	163	151	99	207	126	242	141
1892	160	152	166	98	239	116	278	112
1893	160	176	160	101	221	128	252	142
1894	178	176	175	105	222	126	257	143
1895	162	176	154	98	216	126	260	141
1896	174	190	183	112	212	142	230	151
1897	170	192	163	114	207	127	261	158‡
1898	167	187	167	104	161	126	217	146
1899	160	187	164	104	187	136	229	158
1900	158	177	160	97	202	116	246	159
1901	169	187	165	109	195	128	236	149
1902	176	196	170	111	188	131	227	158‡
1903	184	203	176	110	190	132	218	162‡
1904	172	197	170	108	207	131	252	163
1905	179	201	176	105	205	137	264	144‡
1906	176	205	174	103	202	139	273	157‡
1907	175	206	167	98	216	132	257	131‡
1908	181	198	169	106	197	133	264	159‡
1909	176	213	172	102	218	137	276	152‡
1910	186	211	172	110	213	136	281	145
1911	167	192	170	96	217	140	278	163
1912	179	228	170	108	216	140	275	164
1913	174	229	165	106	232	134	264	
1914	170	228	168	92§	220	138	286	
1915	145	210	140	59§	221	126	270	
1916	155	205	156	52§	208	128	262	
1917	134	198	140	56§	227	119	292	
1918	108	145	126	51§	208	111	269	
1919	137	183	141	68	163	114	184	
1920	196	239	200	124	215	150	258	
1921	185	246	186	117	220	142	273	
1922	160		158					

* See note in preceding table.

† Inclusive of Poland (not given separately these two years).

‡ Based on rates.

§ Returns for 77 departments only.

TABLE I—*Concluded*

YEAR	SIBERIA*	CAUCASUS*	MEXICO†	CANADA†	UNITED STATES†
1880	137				
1881					
1882					
1883					
1884					
1885	135	164			
1886					
1887	141	156			
1888					
1889	136	145			
1890	146	142			
1891					
1892	108	99‡			
1893			70		
1894			78		
1895	146	157	98		
1896	143	174	101		
1897			82		
1898			108		
1899			100		
1900			108		
1901			106		
1902			98		
1903			103		
1904					
1905					
1906					
1907					
1908					
1909					
1910					
1911				190	
1912				207	
1913				204	
1914				216	
1915				220	178
1916				200	169
1917				210	174
1918				153	134
1919				212	172
1920				192	181
1921				200	210
1922					191§

* Means and averages not taken.

† Only averages taken and used in study.

‡ Cholera epidemic.

§ Provisional.

TABLE II
Vital indices of Sweden in groups of ten years

YEAR	0	1	2	3	4	5	6	7	8	9
174										120
175	135	148	132	150	141	137	130	109	103	128
176	144	135	112	106	128	121	135	138	124	122
177	126	116	77	49	154	144	146	132	131	129
178	164	131	117	108	106	111	127	131	127	97
179	100	128	153	142	143	115	141	146	146	127
180	91	115	134	132	128	135	112	119	96	67
181	104	123	111	108	124	147	156	138	138	120
182	135	138	159	153	166	168	154	136	126	120
183	136	117	132	157	131	176	159	125	122	125
184	154	156	150	144	159	169	137	125	154	166
185	161	153	135	132	169	149	144	117	160	174
186	198	176	156	174	166	169	166	157	131	126
187	145	177	184	179	152	154	158	166	165	180
188	162	164	169	167	171	166	179	184	180	174
189	163	168	151	163	165	181	174	174	180	149
180	160	168	172	170	168	164	179	175	172	187
191	176	174	168	170	165	147	156	156	113*	136*
192	177*	173*								

* Provisional.

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